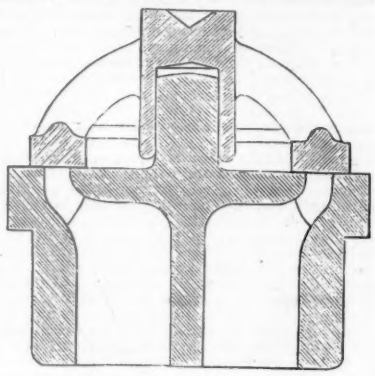
RAILROAD GAZETTE

SATURDAY, FEBRUARY 15, 1873.

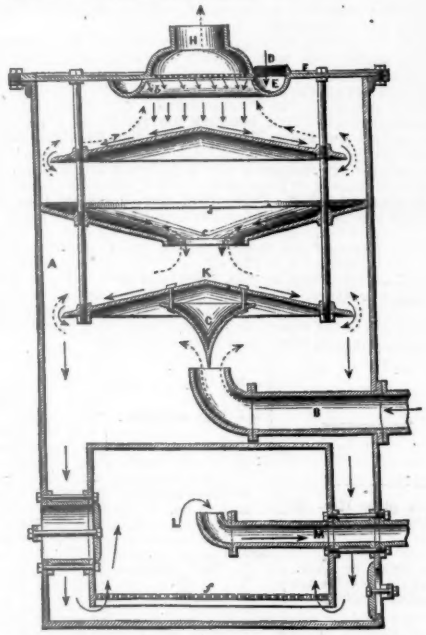
Dawson's Safety Valve.

The engraving represents a section of a safety valve designed and patented by Mr. Walter Dawson, of Scranton, Pa., and applied by him to locomotives. Its construction is so apparent that no description of it is required. The reports of its operation are very favorable, and it seems to fulfill all that is claimed for other and more expensive valves.



Payne's Feed-Water Heater.

This apparatus is the invention of Mr. Benjamin N. and David W. Payne of Corning, N. Y., and is mainly designed as a feed-water heater, but is also applicable as a steam condenser, or both combined, and, if desired, includes also the action of a filter to the water passing through it.



The engraving represents a sectional elevation of it. *A* is a cylindrical outer case or shell, *B* is the exhaust-pipe of the engine, *C* is an inverted cone, arranged over the mouth of the pipe *B*, and serving to spread the exhaust steam as it enters the heater. The inlet *D* for the feed water is at the top of the cylinder and communicates with an annular channel *E* on the under side of the top *F* of the heater, and which is in communication with the interior of the heater by a single or divided opening, *b*, on the inside upper edge of the channel, immediately below a perforated plate which covers the outlet *H*, for the escaping steam. This perforated plate serves to prevent feed-water from escaping with the steam, thereby avoiding the waste of heated water.

The introduction of the feed water through the overflow opening *b* causes it to be forced in a thin sheet into and against a volume of escaping steam, where the water will absorb the most heat and the steam part with its heat most readily. A cone is arranged below the perforated plate *G* at any suitable distance from it, and which may extend to within a short distance of the sides of the outer case or shell. Below this cone is an inverted hollow truncated cone, *J*, having an opening, *c*, at its center. Below the truncated cone, *J*, is another cone, *K*, similar to the top cone, and to which may be attached the steam-scattering cone *C*.

By this arrangement for distributing and directing the courses of the water and steam in reverse directions, the one with the other, as shown by the arrows in full lines and dotted lines, the full-lined arrows representing the courses of the water and the dotted arrows those of the steam, not only is an advantageous distribution of the water and steam effected and the water caused to course in alternate outward and inward directions over and within the cones, but the escaping steam is forced to permeate the water as the latter passes from one cone to the other, and the steam and water brought into the most intimate contact.

L is a filter arranged near the bottom of the heater and insulated, as it were, within it, so as to form a mud-chamber in the bottom of the heater and insure a free exposure of all the sides of the filter for a free passage of the water down past it and up through its perforated bottom *f*, the filtered or pure and heated water finally passing off by a feed-pipe, *M*, to the boiler or elsewhere.

Contributions.

Indicating Slope Lines on Profiles.

ENGINEER'S OFFICE, CHESAPEAKE & OHIO RAILROAD,
HAWK'S NEST, W. VA., November 26, 1872.

TO THE EDITOR OF THE RAILROAD GAZETTE:

Noticing the many articles in your paper tending to promote "the practical" among engineers, the writer is encouraged to call the attention of your readers to an expedient resorted to by the engineers on this road to give the officers of the road and contractors who are interested a better idea of the nature of the work to be met and dealt with on these abrupt mountain slopes.

It is, to put the upper and lower slope lines of excavation and embankment on the profile as well as the center line. The center being usually in black, slopes should be in red, blue or green.

Some of the numerous advantages derived from these lines are:

1. They show the resident engineer at a glance just what part of his work is staked out.

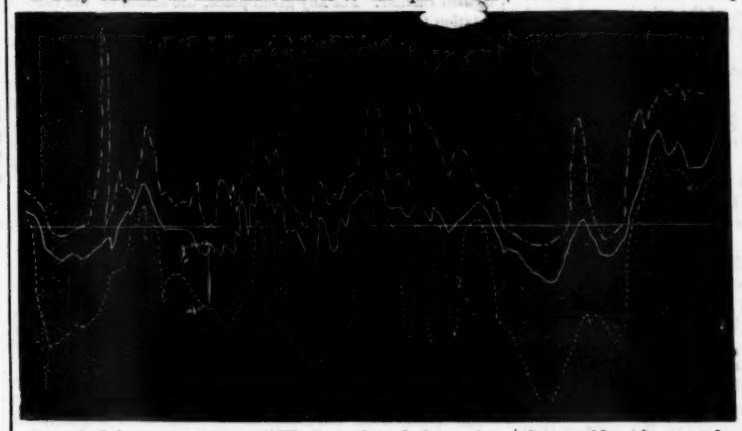
2. They furnish an immediate answer to the qu[illegible] so often asked by contractors, as "What portion of the work is side cutting?" and, "Where does the thorough cut commence?"

3. They show very readily in what way the location may be improved, if at all.

It is not deemed necessary to say anything more for them—for if tried they would commend themselves at once.

They are believed to be novel, and it is hoped they will prove useful.

CABELL BRECKENRIDGE.



Location of Trestle Bents.

CLARKSVILLE, TEXAS, January 23, 1873.

TO THE EDITOR OF THE RAILROAD GAZETTE:

Several of your correspondents seem to have "location of trestle bents" on the brain. Now where the difficulty exists I can't see, for there is nothing to be done but to set the points equidistant from the center of the bent, and radially to the curve.

To illustrate the matter, suppose it be required to locate the ends of the base sills 20 feet in length, with spans of 18 feet and on a 10° curve.

The first step is to set a point at the center of each bent, then to fix the right and left distances of ten feet. Take a tape line and hold the end on one of the centers, and on the next center hold the tape at 10+20.45=30.45 feet, for the inside point, and at 10+20.73=30.73 feet for the outside point; catch up the tape at ten feet and draw taut, and the ten feet will locate the desired points.

The distances 20.45 and 20.73 (diagonals) can be calculated with sufficient accuracy by the following formula:

$$d = \sqrt{\left(s \pm \sin \frac{NB}{22}\right)^2 + \frac{B^2}{4}}$$

where d=the diagonal, s the span of a bent, N the number of degrees of curvature for the span s and B the length of the base side. The formula holds good for tangents as well as for curves.

L. W.

Light Railroads for Light Traffic.

In the article in your paper of January 11, 1873, in relation to the Kansas Central Railroad (unfair as it appears, in part) that part in relation to the oscillation of the cars from the irregularity of the track proves the fact that it must always be so, unless they can procure better roadmen on the narrow than on the common gauge, as ½ inch on the narrow gauge produces the same oscillation as ¾ inch does in the common.

There is no doubt but that in a few isolated cases, and that for short distances, a narrow-gauge road can be constructed considerably cheaper than the common gauge, while in most cases, with the same class of roads there will be no appreciable difference in the cost either of building, working, or maintaining, and capital invested in the narrow gauge. The expectation of large gains will result in disappointment.

The following table of cost of transportation on short roads of different gauges will show that the amount of business, more than gauge, is an index of cost. Each passenger is considered equivalent to one ton, which I think is the common estimate:

NAME OF ROAD.	Gauge.....	Length.....	No. of passengers...	No. of tons	Total expenses....	Cost per ton
	ft. in.					cts.
Festiniog.....	1 11½	13	67,000	137,000	$38,000	29
Lake Champ'n & Moriah	4 8½	7¼	.....	96,000	44,683	46
Montgomery & Erie....	6	10¼	57,000	22,000	27,936	85
Sterling Mountain.....	6	7½	5,000	81,000	27,756	32
Catasaqua & Fogelsville	4 8½	24	21 000	380,000	86,022	21
Warwick Valley.....	6	10	38,000	22,000	32 075	53
Valley.....	6	11½	37,000	611.000	29,064	05
Taunton Branch.....	4 8½	11	184,000	78,000	78,521	80
Cumberland & Pennsylv.	4 8½	34	84,000	1,628,000	531,977	31
Ironton, Pa.....	4 8½	11	.....	112,000	26,033	23
Cornwall, Pa.....	4 8½	7½	.....	312.000	29,622	10
South Mountain Iron...	4 9	17¾	24,000	46,000	16,287	23
Carrolton & Oneida....	4 10	12	4,000	60.000	3,182	05
Iron, Ohio.....	4 10	13	81,000	123,000	89,183	58

There are many expenses which are entirely independent of trade; and of two similar and equally managed roads, the one doing the largest business can do it at a less cost.

Any observing person can see a still greater reason for the unprofitableness of many of the roads, viz., the disproportion between the machinery and the work to be done. How often do we see a 25-ton engine and two 60-seat cars to accommodate an average of not over 20 or 25 passengers. In carefully examining reports, it will be found that many roads carry but from five to ten passengers per car.

It is hard to make owners and managers believe that *their road* is not one of the most prominent and important in the country, and if you propose to them the use of suitable machinery for their work, they become indignant and want another engineer. The engineer in constructing has the same difficulty to encounter.

The writer of this article, in preparing plans for a road over a broken country in the South, a short time since, had to encounter the strong opposition of one of his directors, who had adopted the idea that no road should have a grade of over 25 feet per mile, while I wished to use 80 feet and perhaps more. His idea was to spend a large sum (which they could not raise) to enable them cheaply to do a large amount of work, which they would not have; and my idea was to build a road cheaply that would enable them to do all the work they could get at slightly higher rates for working, but at really less cost, when interest was to be taken into account.

How few of us give a proper consideration to the necessity of the community, in locating a road. Most of us have been taught that a road should be level and straight. Many communities, on the other hand, demand a road for their local necessities that shall not cost over a moderate sum which is within their reach. Theory must harmonize with the necessity and build the best road possible for the money.

I have long been of the opinion that before the close of the present century railroads judiciously constructed would run through every county of our land, and would be good investments to their owners.

D. H. K.

The Official Guide of the Chicago & Alton Railroad.

CHICAGO, February 5, 1873.

TO THE EDITOR OF THE RAILROAD GAZETTE:

I have just read in your paper of the 1st inst. a communication from an able correspondent of yours, in which that heathen "Hindoo" refers to a publication of mine as a "new and useless extravagance," and intimates that "it is no business" of his "if any particular corporation chooses to throw away its money." "Hindoo," in his haste to be critical, has done me an injustice, which I should be loth to believe was done with intent. My railway record, as he can easily ascertain, has been one of economy and not of extravagant outlay. I put it thus mildly. Some of my correspondents put it more strongly. It is quite a change to have the opposite charge made against me. It almost persuades me that I have escaped "the falsehood of extremes." "Hindoo" need have no anxiety about this company throwing away its money. Its executive is not afflicted that way. A more careful examination of the publication which he criticises would have shown him that the Chicago & Alton are simply advertisers in it, and I can assure him that the expense to the company will ultimately be much less than it would cost to print the time-tables separately. He is also in error when he writes:

"Those who were expected to rush for the guides, that they might detach the works of Robert Browning and bind them when completed, will no doubt find it more convenient and no more costly to buy the completed works at some bookseller's store."

No complete edition has been printed in this country. Editions professing to be complete are just about as much so as would an edition of Shakspeare with "Hamlet", "Othello" and "Macbeth" omitted. No uniform and complete edition has been published in England, and the separate volumes would cost there about $20.00 in gold. "Hindoo's" more convenient and no more costly method of procuring Browning's complete works may therefore be pronounced impracticable. "The rush for the guides" has been greater than I anticipated, and they distribute themselves with so much ease and speed that the

experiment proves rather too much than too little of a success. In a limited way, it proves also that the reading public of this country are not what so many gifted persons so complaisantly assume. The elect are sometimes at fault when they modestly take if for granted that they alone have discovered the secret of an author, that he sings for their predestined ears only, and that others have not the grace to listen, the gift to understand, or the taste to appeciate. JAMES CHARLTON.

The Question for Scientists.

TO THE EDITOR OF THE RAILROAD GAZETTE:

If you will be kind enough to permit me, I would like to add a few considerations to the solution presented by Mr. J. E. Hendricks in your issue of the 25th of January, relative to the "Question for Scientists."

For every moving body, the product of the mass multiplied by the velocity (mV) gives what is called the *quantity of motion* at the moment under consideration.

If a body is moving under the influence of a force, and we suppress this force, the body continues its motion until the action of the gravity and other causes of friction, after having gradually diminished its velocity, have brought it to rest, or, more generally, until a resistance has absorbed the *quantity of work* which it can give.

This *quantity of work* may be easily rated; it is no other than the sum of the successive values of the product mV for the different values of V since the moment where the moving force had ceased to work till the instant where the body is brought to rest by a uniformly retarded motion. This sum is usually indicated;

$$\int_{V=0}^{V=v} mV$$

V being the undeterminated value of the velocity; v being the determinated value of the velocity in a given case.

The integral calculation gives:

$$\int_{V=0}^{V=v} mV = \tfrac{1}{2}mv^2$$

Quantity of work or $Q = \tfrac{1}{2}mv^2$

It is this formula which ought to be used for the study of the proposed case.

In effect, we know that the right rail of the track neutralizes by its resistance the action due to the earth's rotation and sustains the *quantity of work* that this rotation imparts to the running trains.

We see, then, that for a given velocity due to the earth's motion the rail must resist a pressure proportional to the square of that velocity and proportional to the mass of the running train. But we yet do not know how this pressure will be divided; as the velocity due to the earth's motion is dependent upon and made appreciable by the velocity of the running train, we must at first see what will be their relation.

Now, it appears easily, as the calculation has been presented by Mr. Hendricks, that uniform velocities of the running train successively double and triple correspond with double and triple velocities due to the earth's motion, which is very approximately true in the limits of our problem. And we may write the following relations:

For *velocities* of the train represented by	Correspond *velocities* due to the earth's rotation represented by	For which the *resistance* of the rail ($\frac{1}{2}mv^2$) will be per second
I	1	$\frac{1}{2}m \times 1$ } Values proportional to the *square of the velocity*.
II	2	$\frac{1}{2}m \times 4$ }
III	3	$\frac{1}{2}m \times 9$ }

And, as we have supposed uniform velocities of the train:

For *velocities* of the train, represented by	Correspond l'gth of rail moved over represented by	For which the *resistance* of the rail per length $\left(\frac{\frac{1}{2}mv^2}{\text{div. by 1 or 2 or 3}}\right)$ will be
I	1	$\frac{1}{2}m \times \frac{1}{1} = \frac{1}{2}m \times 1$ } Values proportional to the *velocity*.
II	2	$\frac{1}{2}m \times \frac{4}{2} = \frac{1}{2}m \times 2$ }
III	3	$\frac{1}{2}m \times \frac{9}{3} = \frac{1}{2}m \times 3$ }

We see that *the resistance of the right rail of the track to the pressure due to the earth's rotation is, in any point, proportional to the mass and to the velocity of the running train.*

It would seem that we may have the the confidence to say now, that if on the road in question the western rail is creeping faster than the eastern one, it is because the value mV is on the average greater for trains going south than for those going north. But, before concluding so positively, let us give ourselves an account by figures and see if really the action of the earth's rotation may be rendered materially appreciable under the ordinary circumstances of the movement of trains.

Before using the formula of quantity of work,

$$Q = \tfrac{1}{2}mv^2$$

I wish to give it under another form, which will make the results that we shall obtain better understood:

$$m = \frac{wt.}{g} \qquad \left(\frac{\text{weight}}{\text{gravity}}\right)$$

therefore,

$$Q = wt.\frac{v^2}{2g}$$

Now, $\frac{v^2}{2g}$ is a familiar expression, which gives the height from which a body must fall to have the velocity v under the action of the gravity:

$$\frac{v^2}{2g} = h$$

then,

$$Q = wt.\,h$$

That is to say: The quantity of work produced by a body having a given velocity is equal to the weight of the body multiplied by the height corresponding to this velocity.

Under this form we see $Q = 1$ for $wt. = 1$ lb. and $h = 1$ ft.

So the unity of quantity of work, or standard for measuring it, is one pound lifted one foot high.

I resume the calculation of Mr. Hendricks, giving the difference of velocity due to the earth's daily motion, per minute, of two points situated a mile apart north and south, by the 41st degree of latitude. And I divide by 60 in order to have this difference per second:

$$\frac{3484 \times 2 \times 3.1416}{1436 \times 60} = 0.25 \text{ foot}$$

I suppose a train weighing 100,000 lbs., running a mile in 180 seconds. The velocity due to the earth's motion that will tend to throw the train on the right rail will be per second:

$$\frac{0.25}{180} = 0.0014 \text{ foot}$$

And applying the formula

$$Q = \frac{wt.\,v^2}{2g}$$

we have

$$\frac{100000 \times 0.00000196}{64.4} = 0.003 \text{ foot pounds.}$$

So $Q = 0.003$ foot pounds for a second and must be divided between the 29.33 feet of rail that has been traversed during this time; that gives an action of about 0.0001 foot pounds per foot of rail.

For a speed of 90 or 60 seconds for the mile, this action will be 0.0002 or 0.0003 foot pounds. And in the most improbable case of a train weighing 1,000,000 pounds having a speed of a mile per minute, the pressure would not exceed 0.003 foot pounds per foot; that is to say, the same as if a pound were falling from the height of $\frac{3}{1000}$ of a foot; or otherwise, the same as if 21 grains were falling from the height of one foot; not even enough to kill a fly!

As we have supposed that we were running south and north, we will observe that for any other direction the results would be still smaller. For any given place, the action of the earth's rotation that will be rendered sensible by the motion of a train will be proportional to the sine of the latitude and to the cosine of the angle made with the meridian.

In concluding, we believe rather that the earth's rotation cannot have any practical influence on the state of our railroad tracks; and if it were possible that its trifling action could be noticed after a long time, it would be first on a double-track road, where each track is permanently appropriated for running in the same direction. E. CHAVANNES.

NEW YORK, February 3, 1873.

Railroad Management—Notes and Queries.

TRAIN DISPATCHING.

"A westward-bound passenger train will wait at a meeting point 20 minutes beyond card time and then proceed, running 20 minutes behind it's own card time *until the expected train is met and passed.*"

A rule similar to the one above quoted (from Ohio and Mississippi rules) can be found among the train rules of most roads operated on the American system. Who originated it cannot now be ascertained. So absurd and palpable a blunder could hardly originate with more than one person claiming to have brains enough to operate a railroad, although by many it might be and doubtless has been copied and carelessly adopted without analysis. In the first place, the rule as to waiting 20 minutes might be good enough in the absence of telegraphic communication; but nowhere can I find any set of rules in which this one is so to be understood. On the contrary, on some roads it is distinctly stated that such waiting is to be gone through and then an order obtained. How much more correct and easier it would be to rule thus:

"If at a meeting point one of the trains fail to arrive in due time, the train that has arrived shall then, without delay, apply for a train order."

Distinct rules should regulate the movements of trains when telegraphic communication is interrupted. As the rule quoted stands, it is constantly violated, for trains do not waste time in waiting, unless the opposing one is likely to be within the specified time. It is the train dispatcher's business to see that trains are not so delayed. Faulty as the rule may be in its first clause, the last one is ridiculous: "*Until the expected train is met and passed.*" What is the aim of this rule? The opposing train is entitled to the track for 20 minutes beyond its card time, and therefore it is necessary to keep the westward train 20 minutes off the time of the eastward train until the passing is effected. Such is the reasoning of the rule under criticism. Let us examine:

Going east, No. 1.		Going west, No. 2.	
A	9 a. m.	A	1 p. m.
B	10 "	B	12 "
C	11 "	C	11 "
D	12 "	D	10 a. m.

Nos. 1 and 2 are due to meet at Station C at 11 a. m. No. 1 is late; No. 2 waits 20 minutes and then goes on, arriving at B at 12:20 p. m., where No. 1 was due at 10 a. m. No. 1 is now 2 hours 20 minutes behind time, and must therefore have lost all right. Why should No. 2 still keep 20 minutes behind its card time, instead of making up as much as allowable?

Alignment of Tunnels.

CINCINNATI, OHIO, January 25, 1873.

TO THE EDITOR OF THE RAILROAD GAZETTE:

Will "Hoosier," or some of the other valuable contributors to your paper, explain the best method of steadying a "plumb line" let down into the shaft of a tunnel, say of 600 feet in depth, and the most certain mode of starting the center alignment of the tunnel in the proper direction from the bottom of the shaft, pre-supposing the needle to be useless?

What method was used in the deep shafts of the Hoosac Tunnel. YOUNG ENGINEER.

—Among the sentences at the late session of the Superior Criminal Court of Berkshire County, Mass., was one of Martin Scriber, of Stockbridge, for five years, for obstructing a railroad track.

Drilling vs. Punching.

The following is a letter from Mr. Walter R. Browne (the author of the paper on "The Strength of Riveted Joints" which we have reprinted recently) contributed to the *Engineer*, from which we copy it:

Throughout the vast industry concerned with plate iron—under its three great heads of boiler work, ship work and girder work—the one universal method of fastening is by forming corresponding holes in the two plates to be united and passing rivets through them. This being so, it might appear strange that the best mode of forming these holes should still be an open question. Such, however, is undoubtedly the fact; and it is to this unsatisfactory state of things that I here wish to draw attention.

The cheapest and readiest method of forming these holes is, of course, that of punching; and in at least nineteen cases out of twenty it is that employed at the present day. It has, however, long been known that in some way or other the operation of punching seriously diminishes the tensile strength of those portions of plate which are left between the holes. This was naturally ascribed to the hardening and bruising of the plate by the violent action of the punch. Hence drilling, which, as being merely the scraping away of the iron under a gentle pressure, could produce no such effect, came to be recommended as a substitute wherever strength was a main object. Another advantage claimed for drilling was that it gave much greater security that the corresponding holes would be made fair to each other, and thus no injury be done to the plates in inserting the rivet. It seems to be admitted, however, that by proper care in the process of punching, and by the use of the rimer instead of the drift where holes do not exactly meet, this defect may be overcome; at least so far that it does not in itself form a reason for resorting to drilling, except where more than two thicknesses of plate have to be united. But on the score of strength the advocates of drilling had it all their own way, and in engineers' specifications for important work, such as the flanges of girders, drilling is often insisted on. Lately, however, experimenters have arisen to impugn the virtue of drilling on its own ground. In the "Transactions of the North of England Institute of Mining and Mechanical Engineers for 1871" will be found a record of experiments which, as far as they went, appeared to show that drilled plates were no stronger than punched ones. They were, however, neither very complete nor very satisfactory. Again, in the course of a discussion upon a paper by the writer on the "Strength of Riveted Joints" ("Transactions of the Institution of Mechanical Engineers," May, 1872), Mr. John Cochrane gave the results of some experiments he had made on pieces of Low-moor and Staffordshire bar iron, and also of Staffordshire plate, in which holes had been made firstly by punching, secondly by punching and afterwards rimering to ¼in. larger diameter, and thirdly by drilling. The strength of the iron per square inch in these three cases differed very slightly; but on the whole the punched plates were the strongest and the drilled plates the weakest of the three, thus absolutely reversing the accepted theory.

So far, therefore, as English experimenters have gone, the verdict might seem to be unreservedly in favor of the punch. Further evidence on the point reaches us from America, and, as it does not appear as yet to have been published in this country, it may here be given in detail. The New York RAILROAD GAZETTE, of July 6, contains the report of a committee "On Boilers and Boiler Materials," to the American Railway Master Mechanics' Association, together with an account of the very interesting discussion which followed its reading. The qustion of drilling or punching in boiler plates had been one of those submitted to the Committee, and they state that of the "Master Mechanics" to whom they applied, a large majority gave their opinion in favor of the former. As, however, no tests of their relative strength were reported, the Committee made a series of experiments on the subject. The pieces tested were in all cases 12in. wide by $\frac{7}{16}$in. thick, and were torn in two by hydraulic pressure. The brand is not given, but all the pieces were from the same plate. The actual breaking strains are alone given in the report, and from these I have calculated the unit strain in tons per square inch, as follows:

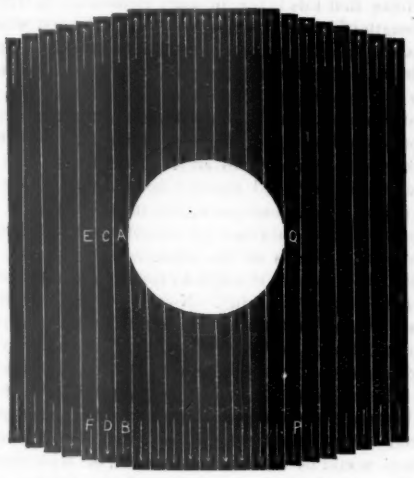
Description.	Experiment number ...	How Broken.	Breaking strain, lbs..	Unit strain on plate, tons per sq. in..	Unit strain on rivet, tons per sq. in..
Entire plate 12in. by $\frac{7}{16}$in.	1	Torn across....	32.228	26.3	.....
	2	do.	32.226	26.3	.....
	3	do.	33.600	27.4	.....
	Mean.	.....	32.685	26.7	.....
Plate 12in. by $\frac{7}{16}$in., with ¾in. hole through middle, punched.....	1	Torn across....	13.371	17.0	.....
	2	do.	13.371	17.0	.....
	3	do.	13.714	17.4	.....
	Mean.	.....	13.485	17.1	.....
Plate 12in. by $\frac{7}{16}$in., with ¾in. hole through middle, drilled.....	1	Torn across....	17.82-	22.6	.....
	2	do.	17.485	22.2	.....
	3	do.	17.622	23.4	.....
	Mean.	.....	17.645	23.4	.....
Two plates, each 12in. by $\frac{7}{16}$in., punched and riveted together with a ¾in. rivet.....	1	Torn through centre of plate	17.828	22.6	25.9
	2	do.	17 828	22.6	25.9
	3	do.	17.143	21.8	24.9
	Mean.	.....	17.599	22.3	25.6
Two plates, each 12in. by $\frac{7}{16}$in., drill'd and rive.'d togeth'r with a ¾in. riv.	1	Rivet sheared..	17.143	21.8	21.9
	2	do. ..	16.457	20.9	23.9
	3	do. ..	15.428	19.6	22.4
	Mean.	.....	16.342	20.8	23.8

On examining the above table, the first point which strikes one is the very high tensile strength of the iron—an average of 26.7 tons to the inch being altogether beyond common experience. It is probable, however, that the iron—both in plates and rivets—was Yorkshire; and Mr. Kirkaldy, in his experiments on wrought iron and steel, records a specimen of Farnley iron which broke under 27.9 tons to the inch, with several others not greatly inferior. There is no reason, therefore, to suppose any error in the apparatus determining the strain.

Turning, then, to the specimens tested after piercing a hole through the center, it will be seen that there is a marked difference in favor of the drilled as against the punched plate. This is, in fact, so considerable, and the results agree so closely together, that they must be taken as decisive of the question whether punching actually injures the plate, Mr. Cochrane's experiment notwithstanding. It will, however, be observed that even in the drilled plate the strength per square inch was considerably under that in the entire plate—22.4 tons as against 26.7 tons. This is highly important, for it has generally been assumed that the strength of a drilled joint is the same as that of a solid plate, except of course for the loss of metal actually caused by the drilling. This diminution of strength is not due, I believe, to any damage done by the drill to the adjacent metal, but to another cause, which, as affecting every description of joint, it may be worth while to investigate.

The figure represents a piece of plate having a hole through the middle, and supposed to be divided into an indefinite num-

ber of parallel and equal fibres. The external pulling forces are supposed to be equally distributed over the plate, as shown by the small arrows. Then it is evident that the portion of the plate, *A B P Q*, being cut off by the hole from the portion opposite to it, will be kept in equilibrium only by the resistances to shearing along the lines, *A B P Q*. These two resistances will then be equal and opposite to the sum of the pulling forces along the face, *B P*. Now, since there is this force tending to shear the portion of the plate, *A B P Q*, or to pull



it forward along the line, *A B*, and since all force produces alteration of form in its own direction, it follows that the portion, *A B P Q*, will be drawn forward along the line, *A B*, so as to project beyond it in the manner shown (of course on an enormously exaggerated scale) in the figure. Again, this shearing strain will be transmitted through the fibre, *A B*, to the next, *C D*, less a certain portion which will be taken up as tensile strain by the fibre *A B* itself. Similarly the strain, still further diminished, will be transmitted through *C D* to *E F*, and so on to the outer edge of the plate, where the shearing strain becomes zero. Now since there is a shearing strain along the line of division between *A B* and *C D*, it follows that *A B* will project beyond C *D*, in the same way as the part *A B P Q* beyond *A B*. Hence the fibre *A B* will be longer than the fibre *C D;* and therefore, as increased extension can only be due to increased tension, the strain on *A B* must be greater than that on *C D*. Similarly, *C D* is more severely strained than *E F*, and so on to the outer edge. Thus, if the pulling force be increased until the plate breaks, the fracture will begin at the points *A Q*, and then extend to the edges. This will clearly take place before the average strain on the parts between the holes and the edges is equal to the ultimate tensile strength of the iron, and thus the result taken in the usual way, would make the metal appear weaker than it really is. In actual experiment the means employed to bring the strain on the plate—in the case before us these are not stated—never produce an equal distribution of the strain over the whole surface, as has been assumed, and as would really happen in a boiler; and, so far, experiment does not give an accurate representation of practice. It is obvious, however, that the same effect would be produced, though not in the same degree. I have myself seen a plate, when tested in Mr. Kirkaldy's machine, crack first between the central holes, and the break slowly extend itself to either edge. This source of weakness has, I believe, never before been brought out by actual experiment. It exists, of course, as much with punched as with drilled holes, but it calls for special notice only in the case of the latter, because in calculating the strength of a drilled joint it has hitherto been assumed that the spaces between the holes might be taken as yielding the full ultimate strength of the metal.

We may now proceed to consider the experiments made with actual riveted plates. Turning our attention first to punched plates, and taking the mean of the experiments, it appears that the plate tore under a strain of 22.3 tons per square inch, the rivet sustaining at the same time the exceedingly high shearing strain of 25.6 tons per square inch. The largely-increased strength of the joint, as compared with the single plate having a hole punched through it, can only be due to the friction of the rivet-head, which is well known to be considerable. The actual breaking strain is 17,599 lbs. as against 32,6?5 lbs. for the solid plate, as the proportion of strength is 54 per cent. This, as is shown in the paper above referred to, very closely represents the best result that could be obtained with punched plates in a single-riveted lap joint.

Turning lastly to the joints with drilled holes, we are at once struck with the fact that the breaking force is actually less than with the punched plates, the mean being 16,342 lbs. as against 17,599 lbs. It would thus seem that drilled plates, instead of beingstronger, are actually weaker than punched plates. It is worth while to examine further into the cause of this weakness. On looking at the table it appears that, whereas the joints with punched holes all gave way by the tearing of the plates, those with drilled holes all gave way by the shearing of the rivets. In the former case the rivets resisted a mean strain of 25.6 tons per square inch, in the latter they gave way under a mean strain of 23.8 tons per square inch. It is clear that there must be some cause—at any rate in these experiments—which makes the rivet in a drilled hole shear more readily than that in a punched one. What is this cause? One speaker in the American discussion before referred to, ascribed the effect to the conical form of the punched holes. If the two large ends of the holes were placed together, then the metal of the rivet filling the enlarged space, would have a greater area to resist shearing. But it did not appear that any care had been taken to place the ends in this manner; and it is besides very doubtful if the part of the rivet within the plate is "upset" to any extent in the process of riveting up. Certainly in my own experience rivets whose heads have been planed off were found to fit quite loosely in their holes. The Committee who made the experiments consider the result to be "probably due to the edge of the drilled holes being sharper and more compact, and consequently more capable of shearing than the edges left by a punch." In confirmation of this view reference may be made to some experiments on steel plates by Mr. Henry Sharp (Trans. Inst. Naval Architects, 1868). Here the rivets, though of Low-moor Iron, were sheared with the very low strain of from 16.76 tons to 20.78 tons per square inch. This was no doubt due to the hard steel cutting more readily into the soft iron.

Similarly, the smooth compact metal of the drilled plate would have more effect on the rivet than the bruised and roughened sides of the punched hole. However this may be, the fact remains that in these experiments the punched joints practically sustained a greater load than the drilled ones. It is true that in the latter case the rivets were clearly considerably weaker than the plates; and thus, by diminishing the pitch, or, what is the same thing, increasing the number of the rivets, the proportion of strength might doubtless be improved. Working the question out according to the information furnished by the present experiments, it appears that the pitch ought to be diminished from 1¼ inches to 1 7-16th inches, and that then the proportion of strength becomes 54 per cent., or the same as that found above for punched plates.

So far, then, as our present knowledge goes, drilling, as a means of preparing riveted joints, has not been shown to possess any advantage over punching, but rather the reverse. I chiefly wish, however, to draw attention to the need which exists for further investigation. Strange as it may appear, the present are, so far as I know, the very first experiments that have been published on drilled plates. On punched plates we have more information; but even that is, in most cases, not wholly satisfactory. It would seem very important that the American experiments should be repeated, and that, not with a single rivet, but with a row properly spaced, and more nearly representing an actual joint. By this means only can the advantages supposed to accrue in drilling from the better matching of the holes be properly taken into account. It would also be desirable to ascertain what system of punching inflicts the least injury on the metal and whether by taking off the edges of a drilled hole, or by other means, the strength of the rivet to resist shearing can be increased. This question of drilling *vs.* punching has been in dispute between engineers and manufacturers for some time past, and should not longer be allowed to rest on a purely theoretical basis. Might it not be possible either for some corporate body, like the Institution of Civil Engineers, or for some combination of gentlemen interested in the decision, to raise a small sum for the purpose of a complete series of experiments, and to set the question at rest for ever?

The Master Mechanics' Asscciation.

The following circulars have been issued by committees of this Association:

MACHINERY FOR REMOVING WRECKS AND ERECTING BRIDGES.

At the Convention of the American Railway Master Mechanics' Association, held in Boston, in June last, the undersigned were appointed a Committee on "The Machinery and Appliances for Removing Wrecks and Erecting Bridges."

Your Committee would respectfully request answers to the following questions:

1. Do you use other wrecking tools than hydraulic jacks, good levers, good tackle and portable frogs?
2. Please give a schedule of tools in what you consider a perfectly equipped wrecking car.
3. Do you consider a derrick car, in addition to ordinary wrecking tools, desirable?
4. Do you know that ordinary wrecks can be removed with greater expedition with the aid of a derrick car?
5. Have you any new and desirable arrangement of cars or appliances for wrecking?
6. If so, please give a description or sketch.

Any information you have bearing upon the subject, not elicited by the above questions, which will aid the Committee in compiling their report, will be thankfully received by

Very truly,
MORRIS SELLERS, Pittsburgh, Pa.,
D. O. SHAVER, Pennsylvania Railroad,
S. MOORE, Pittsburgh, Fort Wayne & Chicago Railway,
} *Committee.*

Please address your replies to Morris Sellers, Pittsburgh, Pa.

MACHINERY FOR SUPPLYING FUEL AND WATER.

At the Convention of the American Railway Master Mechanics' Association, held in Boston, in June last, the undersigned were appointed a Committee on "The Machinery and Appliances for supplying Fuel and Water to Locomotives."

Your Committee would respectfully request answers to the following questions:

1. Do you depend wholly on pumps or injectors, or other similar articles or appliances, or either of them, for supplying water to locomotives?
2. Does it take more fuel to run an engine when injectors are depended on wholly than it does to run one when pumps are wholly depended upon?
3. From your own experience, what is the best method of supplying water to locomotives?
4. Have you any machinery or appliance for supplying fuel to locomotives?
5. Do you know of any better method of supplying locomotives with wood than by hand, or coal with a shovel?
6. What is your method of loading wood and coal on tenders?
7. What is your method of measuring wood?
8. How do you obtain the weight of coal supplied to tenders?

H. L. LEACH, Superintendent Hinkley Locomotive Works,
WILSON EDDY, Boston & Albany Railroad,
E. GARFIELD, Hartford, Providence & Fishkill Railroad,
} *Committee.*

Please address replies to H. L. Leach, Superintendent Hinkley Locomotive Works, Boston, Mass.

OLD AND NEW ROADS.

Berks County.

This company advertises for proposals for the graduation and masonry of 17 sections of the road, extending from Lenhartsville, Pa., to a junction with the Slatington Branch of the Lehigh Valley Railroad near Slatington. Plans and specifications can be seen in the office of the Chief Engineer, J. Dutton Steele, at Reading, Pa. Proposals will be received until March 25.

Chicago, Milwaukee & St. Paul.

The stations and distances from Chicago, on the new line from Chicago to Milwaukee are as follows:

	Miles.		Miles.
Western Avenue	2.8	Russell	46 5
Pacific Junction	6.0	Kenosha Junction	51.6
Montrose	9 0	Trnesdell	52.6
Morton	14.3	Western Union Junction.	61.8
Deerfield	23 8	Franksville	66.0
Libertyville	32.3	Oak Wood	72.8
Warreaton	36.8	Lake	78 2
Gurnee	38 6	Kinnikinnic	83.2
Wadsworth	42 9	Milwaukee	85.0

The time-table, taking effect January 12, shows one freight train running from Western avenue, Chicago, to Milwaukee, and three freights and one passenger train daily between Milwaukee and Western Union Junction.

Selma, Rome & Dalton.

W. T. Lanier has been appointed receiver of this road by the United States District Court for Alabama, on a bill filed by Aimee and others to have the assets administered according to priority of claims.

Detroit, Lansing & Lake Michigan.

Tracklayers on the Stanton Division have reached Stanton, eight miles beyond Sheridan, the late terminus, and 24 miles from Ionia, the junction with the main line.

Gilbert Elevated.

This company reports that it has concluded a contract with English bankers for the sale of $5,500,000 of its bonds at prices which will net the company nearly par in currency. It also reports that it has concluded a contract for constructing five miles of its road, from Chambers street up West Broadway, etc., to Central Park, with the New England Iron Company, of Boston, to be completed this year, and that it is about to let the contract for an extension to High Bridge.

Pennsylvania.

The following act has passed the Pennsylvania Legislature:

"A FURTHER SUPPLEMENT to the act incorporating the Pennsylvania Railroad Company, authorizing an increase of its capital stock, the issue of bonds and the securing of the same by mortgage.

"SECTION 1. *Be it enacted, etc.,* That it shall be lawful for the Pennsylvania Railroad Company, from time to time, to increase its capital stock to such amounts as the stockholders may, by resolution passed at any regular or special meeting, authorize, and when so authorized to apportion or dispose of the said shares in such manner and upon such terms (but at not less than the par value thereof) as the board of directors may deem for the best interests of the company, and the said company may issue, from time to time, bonds of the said company, payable at such time as they may appoint, bearing interest at a rate not exceeding six per centum per annum, with or without provision for the payment by the company of any or all taxes on the principal or interest thereof, and to secure from time to time the said bonds by one or more mortgages of the whole or any portion of the railroads, estate, real and personal, and corporate rights and franchises acquired and to be acquired of the said company; provided, however, that no bond or bonds shall at any time be issued in excess of the amount of the capital stock of said company outstanding at the time of such issue; but any such mortgage or mortgages may, at the option of and to the amount fixed by the said company, be made to secure with the same rights, lien and privileges of bonds which a subsequent increase of capital stock may enable the said company to issue, as well as those which may be issued at the date of the execution of said mortgage.

"SEC. 2. That any mortgage or mortgages executed and delivered, as authorized by this act, shall be recorded in the office of the Recorder of Deeds of the city and county of Philadelphia, and shall thereupon, without further record, be a lien on the property mortgaged, wherever situated, as fully and effectually as if it had been recorded in each of the several counties in which the mortgaged premises, or any part thereof, are or may be situated."

Cincinnati, Huntington & Dayton.

Articles of association were filed with the Secretary of State of Indiana, on the 5th inst., by the Chicago, Huntington & Dayton Railroad; capital stock, $1,000,000. It forms a connecting link in the direct line from Dayton, O., to Chicago.

Texas & Pacific.

A telegram from San Francisco, dated the 5th, said that work was to be commenced on this road in California within a week.

Chesapeake & Ohio.

A telegram from Cincinnati says that the first through freight train from Cincinnati to the seaboard over this road left Cincinnati on the 5th. We are not informed as to how the train reached the Chesapeake & Ohio road, and as no other railroad approaches within many miles of the new part of it, we cannot imagine; but probably the through train started from Huntington and not from Cincinnati.

Shepaug Valley.

The Springfield (Mass.) *Republican* gives currency to the following: "The Shepaug Valley Railroad is in bad repute. One day last week a Litchfield holder of $700 worth of the stock 'swapped' it for a dog."

Boston, Barre & Gardner.

From the fourth annual report of the directors of this company it appears that the receipts for the fiscal year were $69,355, the net income being $4,267. The extension from Gardner to Winchendon, 10 miles, is under contract and being pushed forward vigorously, so that it is expected to have it completed some months before the specified time—January, 1874. The prospects of the road are considered excellent.

The Carondelet Bridge.

The Senate Committee on Commerce voted on the 8th to report favorably the bill authorizing the construction of a bridge across the Mississippi River at Carondelet, Mo., with amendments prescribing substantially the same requirements as to the construction of the bridge which have been inserted in the laws heretofore enacted authorizing bridges over the Mississippi, but providing that this bridge shall be sixty feet above high water, or ten feet higher than any other bridge over the Mississippi.

The Board of Directors of the Merchants' Exchange had, on the 4th inst., adopted a resolution declaring against the construction of any bridge below the mouth of the Missouri River lower than 75 feet above high water mark, or with spans of less than 500 feet wide.

Union Pacific.

In response to the House resolution calling for a statement of the amounts paid to the Union Pacific Railroad Company for army transportation, and an estimate of what said transportation would have cost if the railroad had not been constructed, the Secretary of War transmitted the report of the Quartermaster-General, showing that the Government has paid the Union Pacific Railroad Company for such transportation the following amounts, namely:

During the fiscal year ending June 30, 1867	$111,401
" " " " " 1868	969,286
" " " " " 1869	478,535
" " " " " 1870	487,288
" " " " " 1871	701,246
" " " " " 1872	481,929
" " " which will close June 30, 1873	121,353
Making a total of	$3,351,040

Of which one-half was paid in cash and one-half in credits on account of railroad bond indebtedness to the Government. The Quartermaster-General estimates that the cost of moving the same troops and supplies by stage and wagon would have been $9,850,135, showing an estimated saving to the Government by the railroad transportation of $6,507,283, or about sixty-six per cent.

Rutland.

At the annual meeting of this company in Rutland, Vt., on the 6th inst., it was voted to accept the re-assignment to the Rutland road of the leases (held by the Vermont Central) of the roads on the west side of Lake Champlain, the Plattsburg & Montreal and the Whitehall & Plattsburg and the steamer Oakes Ames, and to surrender those leases to the New York & Canada Railroad Company. The road earned, according to the lessees' report, $980,544 last year, an increase of nearly $80,000 over 1870. The rent paid is 43 per cent. of the gross earnings, $124,500.

Toledo & St. Louis Air Line.

The Toledo, Thorntown & St. Louis and the St. Louis, Shelbyville & Detroit companies have consolidated under the above title. The consolidation was perfected at a meeting held at Indianapolis February 7. An effort is to be made at once to secure means to build the road.

[Continued on page 70.]

RAILROAD GAZETTE

Published Every Saturday.
A. N. KELLOGG & CO., *Proprietors.*
S. WRIGHT DUNNING AND M. N. FORNEY, *Editors.*

CONTENTS.

Editorial Announcements.

Correspondence.—We cordially invite the co-operation of the railroad public in affording us the material for a thorough and worthy railroad paper. Railroad news, annual reports, notices of appointments, resignations, etc., and information concerning improvements will be gratefully received. We make it our business to inform the public concerning the progress of new lines, and are always glad to receive news of them.

Inventions.—No charge is made for publishing descriptions of what we consider important and interesting improvements in railroad machinery, rolling stock, etc.; but when engravings are necessary the inventor must supply them.

Articles.—We desire articles relating to railroads, and, if acceptable, will pay liberally for them. Articles concerning railroad management, engineering, rolling stock and machinery, by men practically acquainted with these subjects, are especially desired.

Advertisements.—We wish it distinctly understood that we will entertain no proposition to publish anything in this journal for pay, EXCEPT IN THE ADVERTISING COLUMNS. *We give in our editorial columns* OUR OWN *opinions, and those only, and in our news columns present only such matter as we consider interesting and important to our readers. Those who wish to recommend their inventions, machinery, supplies, financial schemes, etc., to our readers can do so fully in our advertising columns, but it is useless to ask us to recommend them editorially, either for money or in consideration of advertising patronage.*

BOILER CONSTRUCTION.

Probably most of our readers who are interested in this subject, but especially those who were present at the last convention of the Master Mechanics' Association, have read the paper and the discussion on the "Strength and Proportions of Riveted Joints," by Mr. Walter R. Browne, which has been reprinted in the RAILROAD GAZETTE. This week we publish a review by the same author of the report of the Committee on Boilers and Boiler Material, which latter was read before the Association and at the meeting referred to. Although they have occupied much space, now sadly needed for other matter, we have regarded the investigations of Mr. Browne as having so much value and the subject so much interest as to justify us in excluding other material to make room for what he has written. As many of our readers are very busy and have little time for reading or inclination for working out algebraic formulæ, a brief criticism of Mr. Browne's paper may not be amiss. We will, however, first refer to his article, published on another page of this number, because in it he explains the nature of the strains to which riveted boiler plates are subjected somewhat more clearly than he did in the paper which was written for the Institution of Mechanical Engineers. In the article, "Drilling *v.* Punching," it is shown very clearly that the material between the holes of riveted plates, instead of bearing a uniform tension as has ordinarily been assumed, is really subjected to very unequal strains, when any force is applied to tear them apart.

This is more obvious, we think, when the strain is applied by a pin or rivet, as described in "Drilling *v.* Punching," than it is in the case of a bar with a hole in the center, and to which the strain is applied at each end, as shown in fig. 1. It is quite apparent that if the

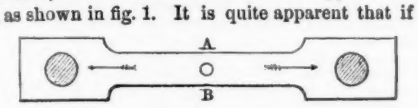


Fig. 1.

strain is communicated by a pin or rivet to a piece of metal similar to that shown in the diagram in the article referred to, the pressure on the mass of metal, *A, B, P, Q*, will be transmitted to the adjoining fibres, as described by the writer; but it is not quite so clear that a similar result takes place when the forces employed to tear apart a bar (fig. 1) with a hole in the center, are applied at each end, and not by a pin or rivet in the hole. The experiments of the Committee of the Master Mechanics' Association have shown very clearly, however, that the bars with holes drilled in them have less strength per square inch than those without, thus indicating that that effect of the strain, although communicated to the ends of the bar, must be somewhat similar to that described by Mr. Browne. That such is the case will be seen very clearly if we take an elastic rubber band, fig. 2, and cut a hole in

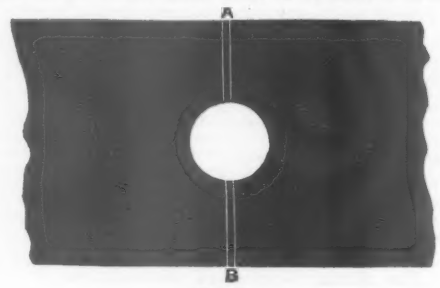


Fig. 2.

it as shown, and then draw two parallel lines, *A, B*, across it and roll each end of the band around a pencil, so that we can stretch it uniformly. If now the fibres of the rubber are subjected to a uniform tension, the two lines will remain parallel when the rubber is stretched. It will be found, however, that they assume the position represented in fig. 3, showing that the

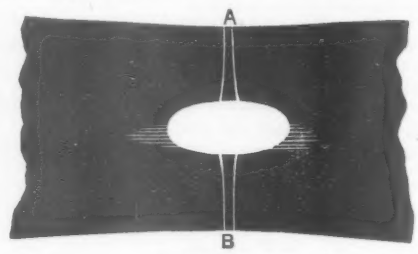


Fig. 3.

fibres nearest the hole are strained more than those on the outside nearer the edge of the band. An exactly similar effect, only to a less degree, must occur when a bar of iron or steel of a similar form is subjected to tension. The metal nearest the hole will be strained more than that nearer the edge of the bar, and consequently will break first. A fracture would therefore probably commence at the hole, and then extend outward, thus breaking the fibres as it were in detail, as Napoleon is said to have defeated armies. This accounts for the weakness of the specimens with drilled holes as compared with the solid bars reported by the Committee of the Master Mechanics' Association. By reference to this report it will be seen that while the solid bar had an average strength of 59,752 lbs. per square inch, the drilled bar broke at 50,270 lbs., and the punched bar at 38,419 lbs. per square inch of section. We have heretofore called attention to this difference, but could not then account for it. It is, we believe, due to the cause pointed out by Mr. Browne, and needs some more careful investigation. To it is due, probably, much of the advantage which has been attributed to drilled plates. It has always been assumed that the material remaining between drilled holes offered as much resistance to strains per square inch of section as the solid plate. That such is not the fact has, we think, been clearly shown, both experimentally and theoretically.

Considering the effects of strains on perforated plates which have been pointed out, we think it is probable that a punched hole has another source of weakness, which we believe has never been recognized. It is well known that a shaft with a sharp corner next a shoulder is more liable to break than if the corner is carefully rounded out. As it is sometimes expressed, the corner *invites* a fracture. Now as the fibres nearest to the rivet holes of boiler plates are subjected to the greatest strain if the edge of the hole is rough and ragged, as is the case with punched holes, a fracture would seem to be more likely to begin than it would if the hole was round and smooth, as it is if well drilled. The ragged edge of the punched hole may probably have the same effect as the sharp corner on a shaft.

What is needed, therefore, is some experiments on a larger scale and made with great care to determine the strength of plates before and after drilling and punching. If specimens of boiler plate from 6 to 12 inches wide were tested without holes, and some of the same width and material were drilled and others punched, and their strength tested, it would afford conclusive testimony regarding their relative strength. Of course it would be an easy matter for persons disposed to show a superiority for one method of perforating plates over another to give the advantage, either by good or bad drilling or punching, to either. It is assumed, however, that railroad managers and those who manufacture machinery for them are interested, not in showing the superiority of their own manner of doing work, but in learning the best way of making boilers.

We have first called attention to the strains about the rivet holes to which boiler plates are subjected, because we believe that this is the primary element upon which the strength of riveted seams depends, and upon which any deductions affecting their proportions must be based. Mr. Browne, therefore, very properly called attention first to the crushing or "crippling" action of rivets on the plates, which more than anything else produces fracture between the holes. Having determined that the resistance of boiler plate to such strains is equal to 40 tons per square inch, and that the resistance of rivets to single shearing is 22 tons per square inch of section, he deduces from these data that the diameter of rivet should be twice the thickness of the plate, with lap joints, in order to have as much strength to resist shearing as the plates have to resist crushing. Now if the results which he has obtained and the values given for the material experimented upon are correct, it shows that the proportions given are the best which can be devised for a boiler seam. Of course the relative proportions are entirely dependent upon the strength of the materials used, and with iron of one quality might be very different from what they would be with that of another, or with steel.

The strength of a boiler seam, instead of being dependent upon the tenacity of the iron between the rivet holes, is really limited more by the power of resistance to crushing which the metal in front of the rivet presents. As soon as this action occurs, as shown in fig. 4,

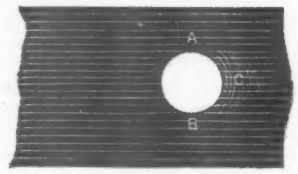


Fig. 4.

the fibres of the iron at *A B* are subjected to an undue strain, and a fracture is liable to begin. It is true their power of resistance to this strain is an element which must be taken into consideration, but the inducing cause which exposes them to this undue strain is the yielding of the metal at *C* to crushing. The strength of the plate is therefore dependent upon the maximum amount of power to resist compression, and tenacity, in *combination*. Very soft metal may have very great tenacity, but might yield so easily to compression as to induce a fracture under comparatively low strains. On the other hand, very hard iron might stand the pressure of the rivet, but yield from the tensile strain.

It should be remembered, however, that the tensile strength which is available for boiler construction is not that of a solid plate, but, as has been shown, is that which the material between the holes will resist. This should be determined as nearly as possible by experiment under the same conditions as exist in the riveted seam. We doubt whether the Committee of the Master Mechanics' Association ever suspected the fact that the strength per square inch of section of a bar to resist a tensile strain is reduced by having a hole in it. It has certainly always been assumed that drilled plates have the same strength as those which are not perforated.

The distance between the rivet holes is also a very important element in the strength of seams, and is one which, unfortunately, cannot be determined by analysis or mere theoretical deduction. As it is necessary to caulk the seams to keep them water and steam-tight, the greatest distance apart at which the rivets can be placed is that which will prevent the boiler from leaking. What is needed with reference to this point is the evidence of practical men who have had the care and repairs of boilers under their control.

That our knowledge with reference to the whole subject is still sadly deficient, is, we think, shown by the fact of the great difference of opinion which exists regarding the controverted question of the relative strength of drilled and punched plates, which Mr. Brown has stated so forcibly. There is one inference, however, which he draws from the experiments of the Committee before referred to, which we think is hardly justified by the facts. From the experiments it will be seen that the drilled riveted plates were torn apart, by the shearing of the rivets, with a less strain than was required to break the punched plates through the center of the hole. From this it is inferred that the drilled seam was actually weaker than the punched one, and the writer has been quoted in such a way as to make it appear that the experiments proved that punched plates are stronger than those which were drilled. The fact is, however, that all that the experiments prove is, that for some not satisfactorily explained reason, the rivets in the drilled holes sheared with less strain than they did in the

punched holes. The weakness was in the rivets and not in the plate. The experiment gives no knowledge of what strain the drilled seam would resist if the rivets were proportioned to the strength of the drilled plates. In the experiments the rivets were too weak. If they had been enlarged there is reason to believe that the drilled seams would have borne considerably more strain than those which were punched. We have learned of some experiments made quite recently with seams of drilled and with punched plates, 12 inches wide. The iron was ½ thick and riveted together with eight rivets (size not given) in double row. The rivets of the punched plates sheared with a strain of 117,500 lbs., and those in the drilled holes at 118,500 lbs. Two pieces of steel ⅜ in. thick, riveted together with ten rivets (size not given), in double rows of punched holes, sheared the rivets with a strain of 149,000 lbs. Two pieces of the same thickness, with drilled holes and the same number of rivets, were subjected to a strain of 150,000 lbs. without fracture. Two of the rivets were then driven out, and the remaining eight were then sheared with 130,000 lbs. strain. It will be seen that in these experiments the rivets showed a slightly greater power of resistance to shearing in the drilled holes than in those which were punched. There was nothing, however, to indicate the relative strength of the drilled as compared with the punched plates. All that the experiments proved was, that in both cases the rivets were weaker than the plates, and that they were as strong in drilled as in punched holes. The vexed question of the effect of punching and drilling is therefore still unanswered.

In this connection there is also another very interesting inquiry regarding the effect of machine and hand-riveting on the strength of seams. In experiments which the writer has made, and which were reported in these pages a few months ago, the superiority of machine over hand riveting in filling the holes was shown very conclusively. This makes it seem probable that machine-riveted seams are the strongest. On the other hand, it is said that the pressure required to force the hot rivet into the crevices of the holes subjects the latter to so great a strain as to reduce the strength of the metal between them. A few experiments would set this question at rest forever, and a comparatively small expenditure of money would contribute information which would be certain to make human life safer, and be of very great benefit to engineers and all who have boilers to use or to build. Who will supply the money to defray the expenses of such experiments?

Railroad Terms.

It is difficult for those who belong to the younger generation of railroad men to realize that the whole of our present railroad system has been developed and perfected within less than forty years. Such, however, is the fact, and there are of course many men still living who took an active part in the first experiments which were made, and helped to construct the first roads and their engines and cars. With the development of such a system there has of course grown up gradually and from the necessities of the case terms and names to designate the appliances, operations and methods employed in the multifarious and complicated business of constructing and working such roads, and conducting their traffic. Considering the magnitude and the importance, both socially and economically, of this modern system, it has been extremely barren in literature, especially in this country. To a very great extent, therefore, no exact or common system of nomenclature exists, and each engineer, superintendent, master-mechanic, car-builder, or other officer or operative has adopted terms of his own, as his inclination or necessities led him. These are good, bad or indifferent, as the ingenuity, taste or dullness of the inventor or author may have suggested. Some are very expressive and appropriate, as, for example, "cow-catcher" and "jerk-water," the latter being the name given to the arrangement for taking up water into a tender while running. Others are very absurd. We have heard, for instance, of a man's ordering a dozen pieces of "wooden putty" for car repairs. He meant the strips of of wood used in car windows for the same purpose as putty is used in ordinary windows. There is, however, in a large number of the terms used very great ambiguity and indefiniteness, the same word being used for different things by different people and at different places. Often a thing is designated by one word at one place and by another somewhere else, so that in transactions conducted by correspondence and telegraph, as railroad business necessarily is, very much confusion and many mistakes are constantly occurring from this source. It therefore becomes daily more and more important that some common system should be adopted for terms employed in the operation of railroads. So great has this necessity become in the car departments, and so embarrassing the confusion arising for the want of it, that the Master Car Builders' Association has appointed a committee to prepare a dictionary of such terms, to report at the next meeting. It is of course very important that such work, if done at all, should be well done, and that whatever is established by the committee should rest upon so good grounds that none of it will ever need to be undone. If names which are not definite, or appropriate, or well conceived, should be carelessly or hastily adopted, it would be impossible, probably, ever to set them right. Some people are very apt to think that one word is as good as another to designate any particular thing, if only all are agreed to apply that word to that special thing. That such is not the case, all who have ever given any thought or study to the construction of language know. Those who have even the most elementary knowledge of science have learned the immense advantage resulting from accuracy in the meaning and use of terms, and in railroad matters, where ambiguity may lead to such disastrous results, it is especially important that the terms used should be clear and without any confusion of meaning.

As the appointment of the committee by the Car Builders' Association is the first step toward the formation of a dictionary of railroad terms, the members cannot exercise too much care in doing their first work—a beginning of what is now much needed.

Record of New Railroad Construction.

This number of the RAILROAD GAZETTE gives information of the completion of track on new lines, as follows:

Detroit, Lansing & Lake Michigan.—The *Stanton Division*, has been extended from its terminus on the 31st of December (16½ miles north of Ionia) north 7½ miles to Sheridan, 24 miles from Ionia. *Utah Northern.*—This narrow-gauge railroad was completed January 31 from Hampton northward 8 miles to Logan.

This is a total of 15½ miles of new railroad.

THE RAILROAD GAZETTE has the kindest wishes for the prosperity and true welfare of all men, and if these wishes are kinder for any class rather than another, perhaps our advertisers are that class. But our kind wishes seem not always to be effective, for here is Mr. R. P. Morgan, Jr., a reputable gentleman, one of the Illinois Railroad and Warehouse Commissioners since the organization of the board, who, being a civil engineer and the son of a civil engineer, pretty well acquainted with the circumstances which affect the traffic of a railroad, and therefore qualified to judge of the prospective value or want of value of new railroad schemes, has offered his services to examine and report upon such railroads for intending investors and others; and, in order to reach such parties, has advertised his business in the RAILROAD GAZETTE, beginning before he was Railroad Commissioner. But, being a candidate for reappointment to the office of Railroad and Warehouse Commissioner, being urged for the place by the people whom the Governor was supposed to desire most to favor, and, moreover, having general qualifications quite equal to those of any of the candidates, probably, and the further and very important one of experience in the office, Governor Beveridge selected some one else in his place. This, as politics go, of course is not at all strange; what is strange (and what cuts us to the heart) is his reason for so doing, which a telegram to the Chicago *Tribune* reports as follows:

"The Governor is said to assign as his reason for not appointing Morgan that Morgan had an advertisement in a railroad paper calling for business as engineer to lay out railroads, and do similar work coming within the scope of a civil engineer."

And has it come to this, that he who advertises in the RAILROAD GAZETTE shall be denied that great and glorious privilege of every American citizen, the right to hold office? And must we lose our advertisers or must they lost their offices and emoluments? Is Governor Beveridge determined to c-r-ush the RAILROAD GAZETTE by frightening away its patrons, assuming that they are all in Illinois and that all Illinoisans (as, indeed, he has had some reason to think) are candidates for Railroad Commissioner? The American eagle itself would hardly be equal to a case like this.

THE NEW LOANS raised by corporations and nations during the year 1872, according to the *Monileur des Interets Materials*, a Belgian financial journal of great ability, amounted in gross to about $2,525,000,000, about $405,000,000 of which, or nearly one-sixth of the whole, was raised for American countries and companies. Of this latter amount, $220,000,800 was for railroad "and other industrial companies." As we completed more than 7,300 miles of railroad last year, and new projects have been about as numerous as ever (perhaps not quite so successful, however, in negotiating their bonds) at $20,000 a mile, these companies could have disposed of $146,000,000 of this amount in the United States alone.

THE RAILWAY ASSOCIATION OF AMERICA, we learn, has received the adhesion of a number of companies since it became a national society, and it promises fair to become really a national association and truly represent the railroad interests of the country.

The Rand & Waring Air-Compressor.

The use of compressed air for transmitting power is rapidly extending, and is being applied to a great many purposes. The necessity for its use in tunnelling has drawn attention to it, and in perfecting the appliances for that purpose it has been found equally well adapted for others. It seems certain that it will be substituted in many places for existing methods of transmitting power for long distances, and for distributing it over large areas. It can be carried almost any distance, by the most tortuous channels and at any temperature, without material loss of power, and can be applied in any locality, whether at the bottom of a mine, or the top of a mountain, in a crowded room or in the open air. For these reasons it seems to be admirably suited for supplying power to railroad shops and other manufactories which are often scattered over large areas or located at considerable distances apart.

The engraving which we give of the Rand & Waring Compressor, which was exhibited last fall at the Fair of the American Institute, and the following admirable description written by Mr. Geo. D. Emerson will at the present time have especial interest for our readers:

The great obstacles to the more general use of compressed air as a motor, or vehicle for the transmission of power, have been the great losses incurred through the friction of the additional machinery, and through the heat generated by the compression; the last has hitherto been much the most important source of these losses.

In a paper from the hand of Prof. J. W. Macquorn Rankine, which was read before the Institute of Engineers of Scotland on the night of the death of Professor Rankine, the following paragraph appears, as reported in London *Engineering*:

"In transmitting power by compressed air, there were great and unavoidable losses of power in the air-compressing engine, arising mainly from the waste of heat developed by the compression of air. The losses seldom amounted to less than 65 to 75 per cent. of the whole power of the compressing engine, and it could be shown that in extreme cases they might exceed 90 per cent."

In the discussion called out by the reading of the paper, the following remark was made by one of the members: "The loss of 65 to 75 per cent, which occurs in air-compressing engines exceeds many times the loss theoretically due to waste of heat; and we may therefore expect to see it greatly diminished through the gradual improvement of machinery." The truth of this remark will be readily recognized by any one who has made the laws of thermodynamics a special study; for if the compressing vessel could be made of a *perfectly conducting* material, the heat would flow out as fast as generated, and no additional resistance would be caused by it, and though this ideal condition can never be absolutely realized in practice, yet the conducting power of metals allows an approach to it sufficiently near to give very valuable economical results, where the machinery is so arranged as to carry off the heat from the compressing vessels as fast as it is absorbed by the metal of the inclosing cylinder. The excessive heat must be absorbed during the process of compression and before the air leaves the compressing cylinder. If a volume of air at 60 deg. Fahr. could be compressed five volumes into one, in a perfectly non-conducting vessel, the heat generated would be about 494 deg., and the increased resistance would be about 93 per cent. more than that which is due to five atmospheres, or equal to about 9.64 atmospheres; but if it were compressed in a vessel capable of absorbing the heat nearly as fast as generated, only a small portion of this resistance would be encountered.

The compressor described in this article is so constructed as to remove the excessive heat by providing for its absorption and conduction through all inclosing surfaces, which surfaces are kept cool by a free circulation of water behind them.

Ample experiment has proved that it is capable of absorbing all objectionable heat with sufficient rapidity to allow any desirable speed in the movement of the compressing piston; the heat being carried away by a flowing current of water surrounding the compressing vessels, but out of contact with the air itself. A piston of twelve inches diameter, compressing to four atmospheres, has been moved for several consecutive hours, at the rate of more than four hundred and fifty feet per minute, producing only a very slight and altogether unobjectionable warming of machinery.

The compressing cylinder is composed of three concentric shells, which form two annular spaces around the working cylinders. The outer space affords a passage for the air after compression, and also a vessel for collecting any moisture that there may be in the air; the inner space forms passages for the water used in cooling. The outer double cylinder is cast in one piece; the inner one, in which the piston works, is cast and turned separately, and fitted to bearings in the outer. It is merely a thin metallic lining, resting upon bearings which are continuous throughout the whole length at top and bottom, but are placed at intervals on the sides; these continuous bearings divide the adjacent annular spaces into two parts for the purpose of making the circulation of water more complete. The heads of the cylinder are also hollow for the reception of the cooling water and to afford passages for the air.

The piston and piston-rod are also hollow, with passages to permit the flow of water through them. The piston-rod passes through both heads of the cylinder, and the part which extends beyond the outer end is inclosed in a water-tight casing. A tube somewhat smaller than the bore of the piston-rod is fixed at the extreme end of the casing and extends in the bore of the piston-rod through the entire length of the cylinder. This affords water passages through the piston and piston-rod.

A gland or diaphragm, preferably of some slightly elastic substance, is fixed in the bore of the piston-rod near the center of the piston. This gland is fitted to and slides over the tube, during the movement of the engine, and compels the flowing water to pass through suitable pipes into, around and out of the piston into the bore of the rod beyond. The tube takes the water back out of the machine after it has passed the whole length of the piston-rod. A minor difficulty in the use of compressed air as a moter, though one which in some cases has assumed considerable importance, is the clogging of pipes and passages, and particularly the exhaust ports, by ice. This is formed from the precipitation of the moisture of the air as the result of cooling. The capacity of the air for holding moisture decreases with any reduction of temperature. If the air at a high temperature is saturated with water, and then allowed to cool, it will release and precipitate a part of the water which is held in suspension at the higher temperature.

When air has been compressed, and the heat generated by compression taken away, if any expansion or reduction of pressure is allowed, the air is cooled to such a degree that a small rate of expansion reduces its temperature below the freezing point, and ice attaches to the enclosing vessels.

The systems of compression generally used in Europe overcharge the air with moisture, by exposing it during compression to direct contact with the water, either by the use of the oscillating water column or of a spray injected through the compressed air. In some of the English coal mines great expense has been incurred to overcome this difficulty.

In one instance at least the operation of the machinery devised for cooling by the introduction of water into the cylinder has been entirely suspended during the winter, in consequence of the difficulty encountered by the production of ice.

It is the belief of the proprietors of the Rand & Waring Compressor that the system of dry compression, which is applied in that machine, will place this difficulty under better control than any other yet devised.

The parts of the machine devoted to cooling are such as to give perfect control of the supply of water, the amount of which, under all ordinary circumstances, has been determined by calculations verified by experiment. Means are provided for regulating the supply to suit any difference of compression, climate or temperature of the outer air. The water may be introduced into the cylinder by a pump, either attached or independent, or it may be supplied through a simple pipe, from a head affording suitable pressure. It enters the extreme end of the cylinder and passes along the annular space through the whole length to the head at the opposite end; thence, passing around the valve chambers and piston rod, it enters the opposite side of the annular space around the cylinder, and, returning the whole length of the cylinder, passes into the hollow head near which it first entered the machine. From this head it enters the casing beyond the extreme end of the cylinder, above mentioned, which casing contains the prolonged piston-rod and small tube; thence it passes into the bore of the piston rod and flows forward to the gland at the piston. This gland cuts off the direct passage of the water outside of the tube and

forces it through suitable pipes, on opposite sides of the gland, into, around and out of the piston, whence it continues its course along the bore of the rod beyond to the open end of the tube, and, entering there, passes back through the tube out of the machine.

This system of circulation places a current of flowing water behind every part of the compressing machinery with which the air comes in contact during compression, while cool water is continually supplied as fast as it is required.

The air-valves are of the class usually called bonnet or conical valves. They are operated both ways, principally by air pressure produced by the action of the machine, but are held to place by slight spiral springs. The inlet or induction valves open directly from the external air to the interior of the compressing cylinder, through casings which pass through both shells of the cylinder head. They are mounted in movable housings for facility of repair. The outlet or delivery valves are hollow cases, which can be readily drawn out by removing a cap. Their automatic action is perfectly simple: as the piston moves away from either head of the compressing cylinder, the inlet valves open and admit the outer air to fill the space swept through; as soon as the end of the stroke is reached, the pressure on both sides being equalized, the valves are closed by the light spiral springs; as the piston returns, it compresses the air which has been drawn into the cylinder until its density somewhat exceeds that of the receiving tank or reservoir, when the outlet valves open and the compressed volume is forced through them, the valves closing by the action of the springs when the end of the stroke is reached.

The lubrication of the working cylinder by water is effected through a space in the piston, between the two sets of packing rings, communicating with the water in the hollow chamber, which is forced outward by the pressure which causes the circulation. This wets the whole interior periphery of the cylinder with a thin film of water as the piston moves through it.

A very simple attachment has been made, by which all the water may be driven out of the machine in a few moments time, to prevent freezing when not in use, or for any other purpose. This is done by simply shutting off the water cock and turning on the compressed air into the water passages.

The application of the steam power through an inclined steam cylinder forms an important feature of this machine. The object is to apply the greatest effort of the steam at the instant of the greatest resistance of the air. In a direct-acting compressing pump, that is, one in which the steam and air pistons work on the same line, there is very great inequality between the power and the resistance at corresponding points in the stroke, particularly if any expansion is used. In such a machine this can only be overcome by the use of fly-wheels disproportionately large; but by the use of the inclined steam cylinder, this enemy is turned into an ally, the economy of expansion is secured to any desirable extent, and the machine is much simplified.

In case the steam is cut off at four-tenths, and its maximum pressure is two-thirds that of the condensed air, the greatest excess of resistance over the effort at any point of the stroke is only about one-tenth of the maximum air pressure, and this only for a very short portion of the stroke.

Fig. 1 is a card on which is delineated the theoretical pressure

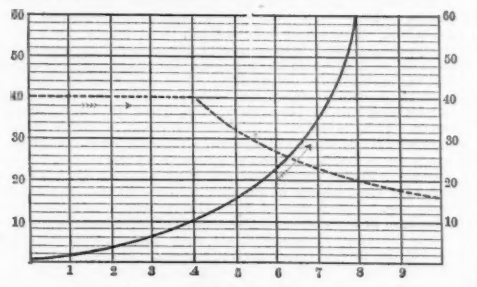


Fig. 1.

of the steam and air at each tenth of the stroke, the dotted lines representing the steam, and the continuous lines the air. The maximum steam pressure being 40 pounds, cut off at four-tenths, the air being compressed five volumes into one, or 60 pounds to the square inch. The vertical lines indicate each tenth of a stroke, the horizontal lines showing the number of pounds per square inch, expressed by figures adjacent to each of them. At eight-tenths of stroke, the air, having reached the required density, is supposed to open the outlet valves, and thence to the end the pressure is constant. It will be seen that the steam power is enormously excessive at the beginning, and very deficient towards the end of the stroke, though the aggregate power is to the aggregate resistance about as 31 to 24. It should be stated here, that in both these cards the steam and air are treated as isothermal gases, no allowance being made for the loss of heat by expansion of steam, or its increase by compression of the air. The latter would be an important item, but it is not necessary to consider it for the purposes of this illustration.

Figure 1 also shows that during the last four-tenths of the stroke the power is greatly less than the resistance, and during the last two-tenths it is less than one-third of the resistance. Every mechanic will perceive that this excessive resistance in so large a part of the stroke could not be overcome, in a machine working at any practical speed, without fly-wheels of enormous proportions.

Figure 2 shows the effect of so inclining the steam cylinder

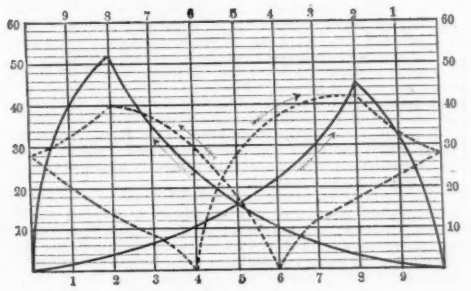


Fig. 2.

that its greatest effort will be given at the instant of the greatest resistance of the air. All conditions of the steam and air are supposed to be the same as in figure 1. It represents both the forward and backward stroke.

The diagram is not simply a pressure card, but represents also the effect of the position of the crank-pin, thus giving the sum of all resistances and efforts at each point of the forward and the backward stroke. It shows that the dead point of the steam end occurs when the air pressure is light, demanding but small duty from the fly-wheel. It shows also that while the pressure of the air upon the piston is 60 pounds, its effort upon the crank-pin is only 45 pounds on the forward and 53 pounds on the return stroke, owing to the position of the pin in its circle of rotation.

This arrangement insures a very much nearer approach to parallelism between the power and the resistance at all points of the stroke than is obtained in ordinary machinery, where the resistance is constant, and the power is transmitted through a revolving crank.

Train Accidents in January.

On the morning of the 1st, at Townsend's station, on the West Pennsylvania Division of the Pennsylvania Railroad, a west-bound coal train ran into the rear of an express train which was taking in water at the station, killing one passenger and slightly injuring another. It is reported that the engine of the coal train had broken an axle and been detained thereby and fell behind the express, but afterwards ran ahead of its time in violation of orders.

On the morning of the 1st, near Mason City, Ill., on the Western extension of the Indianapolis, Bloomington & Western Railway, a construction train ran off the track.

On the morning of the 1st, about two miles below Joliet, Ill., on the Chicago & Alton Railroad, a north-bound freight and a south-bound passenger train ran into each other, the engines striking at a speed of about ten miles an hour each, and being utterly wrecked, with their tenders and the express car. The enginemen and firemen of both engines saved themselves by jumping, and the passenger cars are believed to have been saved from telescoping by the Blackstone platforms. The freight is said to have been running on the passenger train's time, the engineman of the freight saying that "he thought" it was Sunday instead of New Year's Day, and that there would be no passenger train on the line. The express was seven minutes late and running at high speed to make up time. The trains came in sight of each other when close together, the freight coming down a grade; but the express engineman set the Creamer spring brakes instantly on all the cars, which, without reversing the engine, brought the speed down materially before the shock. No one was hurt much.

On the 1st, near St. Lawrence, Minn., on the St. Paul & Sioux City Railroad, a freight train jumped the track and was wrecked.

On the night of the 1st, near Sibley, Minn., on the St. Paul & Sioux City Railroad, the first car of a freight train jumped the track and was followed by several others, one of which landed bottom up in the ditch.

About the 1st, part of a passenger train on the Connecticut & Passumpsic Rivers Railroad was thrown from the track by a broken rail two miles south of Barnet, Vt. The locomotive and baggage car passed over safely, the trucks of the smoking car were broken, and the first passenger car went down the bank and landed bottom up. Five passengers were somewhat injured.

About dawn on the morning of the 2d, an engine ran off through an open switch at Bluff's Station, Ill., on the Toledo, Wabash & Western Railway, blocking both main and side tracks, and delaying trains three hours.

On the morning of the 2d, on the Macon & Western Railroad, 30 miles below Atlanta, Ga., there was a collision between north-bound and south-bound passenger trains, by which three cars and one engine were wrecked, and eight persons killed and 14 injured. The north-bound train should have waited for the other to pass at a station below, but it is reported that the engineman, fireman and "wood-passer" on the engine of this train were all asleep when they passed this station.

On the morning of the 2d, a switching engine on the Chicago & Northwestern Railway ran into the rear of a passenger train near the depot in Chicago, throwing the rear car from the track and damaging it somewhat.

On the morning of the 2d, as two freight trains, one following the other, were passing Casselman, Pa., on the Pittsburgh, Washington & Baltimore Railroad, the rear one ran into the other, throwing a brakeman upon the track, and killing him, and slightly injuring some cars.

On the 2d, on the Chicago & Southwestern Railway, a mail train was delayed five hours by the breaking of a wheel under the locomotive.

On the afternoon of the 2d, near Parryville, Pa., on the Lehigh & Susquehanna Division of the Central Railroad of New Jersey, a down passenger train ran into a loaded up coal train that had just left the station and was moving slowly, demolishing both locomotives and killing both enginemen. All the passenger cars remained on the track. It is reported that a danger signal was set for the passenger train, but it is supposed that a thick mist prevailing at the time concealed it from the engineman; which would indicate a proper time for the use of torpedoes.

On the afternoon of the 2d, at Park Hill, Ont., on the Grand Trunk Railway, 150 miles west of Buffalo, a passenger train was thrown from the track by a broken rail near an iron bridge, killing the baggageman and a brakeman and injuring the engineman.

On the afternoon of the 2d, at Castleton, Vt., on the Rensselaer & Saratoga Railroad, as a train was passing over a bridge near the station one of the driving axles broke square off close to the wheel, and the wheel rolled off the bridge and into the river. No other damage was done.

On the evening of the 2d, on the Chicago & Clinton line of the Chicago & Northwestern Railway, just east of Sterling, Ill., eight cars of an east-bound freight train were thrown from the track and down 20 feet into the Rock River by the breaking of a rail.

On the night of the 2d, as a freight train was passing over the Lake Superior & Mississippi Railroad near Pine City, Minn., a large ox broke through the end of a stock car, fell upon a trestle bridge, and threw the train from the track, and four cars over the bridge, badly damaging them.

On the 3d, about noon, near Havana, Minn., on the Minnesota Division of the Milwaukee & St. Paul Railway, three cars of a south-bound passenger train jumped the track and fell on their sides in the ditch, severely injuring seven passengers. The train is said to have been running but ten miles an hour at the time.

On the afternoon of the 3d, a baggage car and three coaches of a north-bound passenger train on the Beaver Valley Branch of the Pittsburgh, Fort Wayne & Chicago Railway were thrown from the track and down an embankment by a broken rail, and two of the coaches were burned. Two passengers were seriously injured, and 19, including a brakeman, slightly. None were injured by the fire.

On the night of the 3d, as a south-bound train was hauling, at its rear, an engine which had been wrecked by a collision on the 1st, just below Joliet, on the Chicago & Alton Railroad, the wrecked engine broke off while ascending a steep grade, and ran back with great speed into another engine which was standing on the track, making it also a candidate for repairs.

On the morning of the 4th, near Wenona, Ill., on the Illinois Central Railroad, four cars of a south-bound freight train were thrown from the track by a broken rail.

On the morning of the 4th, at Lordville, on the Erie Railway, an extra freight train ran into another extra freight which was standing at a water tank, wrecking both engines and eight or ten cars.

On the morning of the 4th, at Livonia, N. Y., on the Rochester Branch of the Erie Railway, a passenger train was thrown from the track by a switch believed to have been maliciously misplaced.

On the morning of the 4th, on the Stillwater Branch of the Lake Superior & Mississippi Railroad, a passenger train was thrown from the track by a misplaced switch, injuring the conductor severely, and the brakeman slightly, and breaking up the baggage car and one coach.

On the 4th, near Irving, Michigan, on the Grand River Valley Division of the Michigan Central Railroad, a wheel broke in the truck of the locomotive of a passenger train, and the engine went through a bridge. The passenger cars remained on the track and no one was hurt.

On the afternoon of the 4th, near Hastings, Minn., on the River Division of the Milwaukee & St. Paul Railway, the engine of an east-bound express jumped the track at a curve just in front of a bridge, ran over the bridge, and dragged the train after it on the ties, but without much damage, except to the track, the baggageman being slightly hurt. The breaking of a flange on the engine truck is assigned as the cause.

On the morning of the 5th, near Nineveh, N. Y., on the Albany & Susquehanna Railroad, a coal train was run into a side track to permit a passenger train to pass it, but the switch by which it entered the siding was not replaced for the main track, and so the passenger ran into the coal train, wrecking several cars and injuring severely the engineman of the passenger train, who stuck to his engine.

On the morning of the 6th, near Edwards Station, Ill., on the Peoria Branch of the Chicago, Burlington & Quincy Railroad, the baggage car and two coaches of a passenger train were thrown from the track and down a bank eight feet high by a broken rail, the last coach falling on its side. Nine persons were injured.

On the morning of the 6th, a passenger train on the Portsmouth & Concord Railroad was thrown from the track near Candia, N. H., damaging the engine.

On the afternoon of the 6th, an engine jumped the track about a mile above Ringgold, Pa., on the Philadelphia & Reading Railroad, blocking the road for some time.

On the night of the 6th, near Leavenworth, Kan., on the Missouri Pacific Railroad, an east-bound express train, consisting of sleeping car, two coaches, baggage car, engine and tender, was thrown from the track. A defective switch is reported as the cause.

On the morning of the 7th, at Red Bank, Pa., on the Bedford Division of the Pennsylvania Railroad, there was a collision between two freight trains, by which one engine and several cars were thrown from the track.

On the morning of the 7th, near Seville, Ill., on the Toledo, Peoria & Warsaw Railway, a rail broke under the engine of a west-bound passenger train, and the baggage and express car went down the bank, seriously injuring the express messenger.

On the morning of the 7th, at Sullivant's Hill, three miles west of Columbus, Ohio, on the Little Miami Division of the Pittsburgh, Cincinnati & St. Louis Railway, a defective rail broke under the engine of an accommodation train running at full speed, and baggage car, smoking car and coach jumped the track and rolled down the embankment. The express messenger and a passenger were severely hurt.

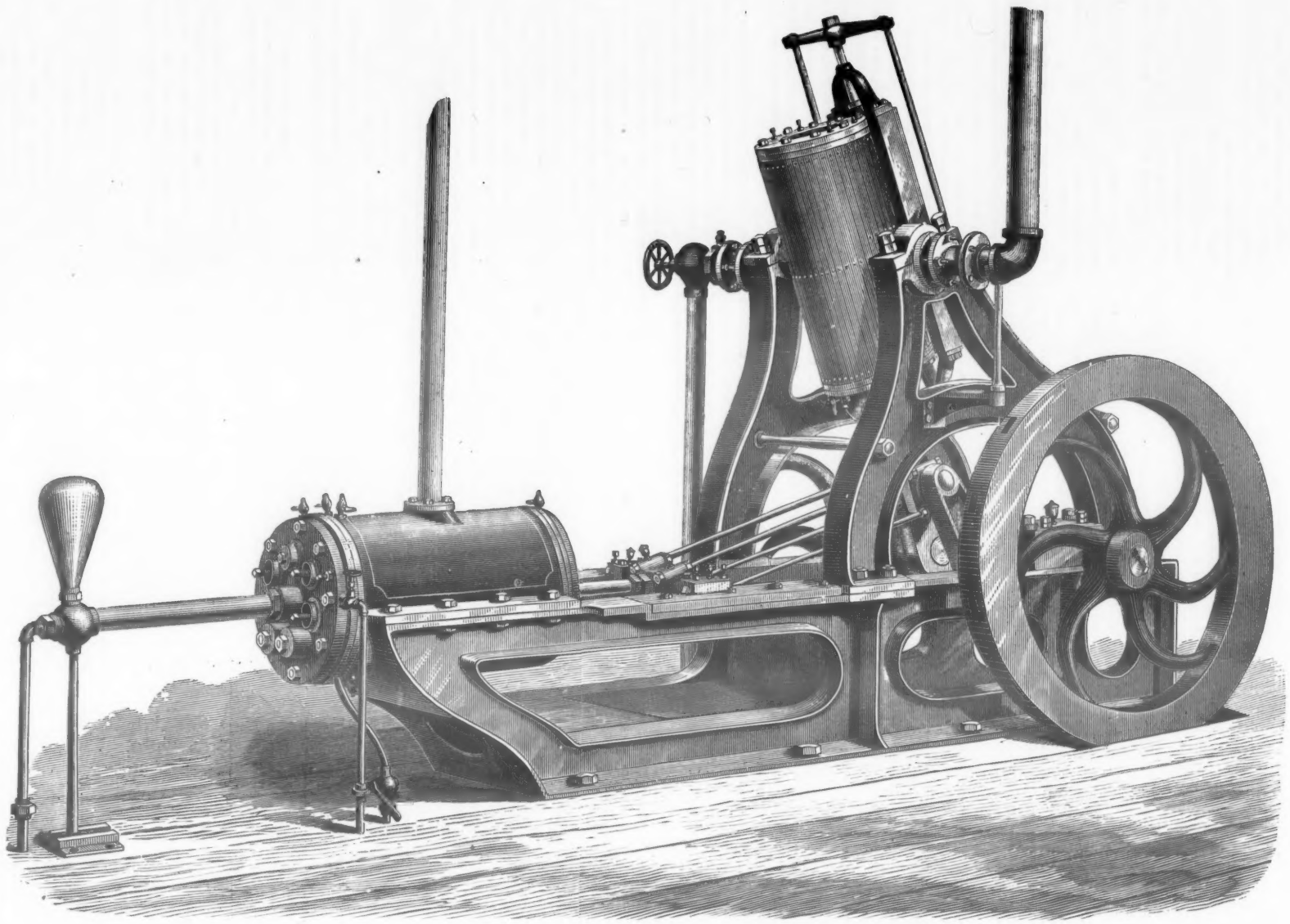
On the 7th, while going down a steep grade near Tremont, Ill., on the Indianapolis, Bloomington & Western Railway, nine cars of a freight train jumped the track and went into the river.

On the 7th, at Moss Bank near Danville, Ill., on the Indianapolis, Bloomington & Western Railway two or three cars of a train were thrown from the track into a ditch.

On the afternoon of the 7th, about two miles north of St. Joseph, Mo., on the Marysville Branch of the Kansas City, St. Joseph & Council Bluffs Railroad, a special train conveying general officers of the Chicago, Burlington & Quincy Railroad was thrown from the track at a point where section-men had removed a rail and neglected to set signals. The locomotive was upset.

On the morning of the 7th, on the Kinkora Branch of the Amboy Division of the Pennsylvania Railroad, a wash in the road-bed caused a passenger train to leave the track, and a coach was broken up and the tender ditched. The conductor and one passenger were slightly injured.

On the night of the 7th, at Belmont Station, on the Louisville & Nashville Railroad, three cars of a passenger train were thrown from the track by a broken rail. One of these turned



RAND & WARING AIR COMPRESSOR,

For Driving Rock Drills, Pumps, Hoisting and other Machinery, Patented July 16, 1872, and August 20, 1872.

RAND & WARING DRILL & COMPRESSOR CO., 21 PARK ROW, N. Y.

over and caught fire, but was soon extinguished. Seven passengers were severely injured.

On the afternoon of the 8th, at Oak Ridge, N. J., on the New Jersey Division of the New York & Oswego Midland Railroad, as a west-bound freight train was backing into a switch, an east-bound train, nine minutes ahead of time, came up and ran into the engine of the backing train. The engineman of the east-bound train was killed in jumping from his engine; a flagman remained on this engine until after the shock, and was unhurt. A brakeman was slightly hurt. Neither engine was disabled.

On the afternoon of the 8th, at Middletown, N. Y., on the New York & Oswego Midland Railroad, a freight train (whose engine had been run into at Oak Ridge the same afternoon) had several of its cars jump the track, some of which were dragged against some trestle work and broke it down.

On the evening of the 8th, a mile or two south of Pekin, Ill., on the Peoria, Pekin & Jacksonville Railroad, the baggage car and a coach of a north-bound passenger train were thrown from the track by a broken rail, and the conductor was slightly hurt.

On the night of the 8th, near Caledonia, Wis., on the Madison Division of the Chicago & Northwestern Railway, a passenger car was thrown from the track and on its side, injuring two passengers considerably.

About 1 o'clock on the morning of the 9th, on the Rome, Watertown & Ogdensburg Railroad, about 15 miles north of Watertown, N. Y., an entire passenger train, consisting of two locomotives, baggage car and two coaches, was thrown from the track and the engines were badly broken, one of them being left on its side in the ditch. The telegram reports that the cause is supposed to be the ice which had frozen in the flanges.

On the 9th, while working through a snow-drift near Monroe, Iowa, on the Des Moines Valley Railroad, the two locomotives on a passenger train and two coaches went into the ditch.

On the night of the 9th, on the Galena Division of the Chicago & Northwestern Railway, two miles west of Franklin Grove, Ill., the engine and four cars of a west-bound mail train jumped the track and went into the ditch.

About 2 o'clock in the morning on the 10th, an express train on the Western Union Railroad ran off the track between Freeport and Florence, Ill., and the baggage and express car and one coach went into the ditch.

About 3 o'clock in the morning on the 10th, the baggage car, two coaches and a sleeping car of a west-bound express train on the St. Louis, Kansas City & Northern Railway were thrown from the track and down the embankment by a broken rail, near Montgomery City, Mo. The sleeping car took fire from the stove, but was extinguished before much damage was done. One passenger was severely injured.

On the morning of the 10th, at Callicoon, N. Y., an express freight train on the Erie Railway ran into the rear of an express passenger train, which had been stopped on the track by the stalling of a freight train in front of it. The passengers mostly left the rear car (a sleeping car) before the shock, but one was caught on the rear platform and had his leg broken. The car caught fire and was burned, as there was no water near and the trains were immovable.

On the 10th, at Boonville, Mo., on the Boonville Branch of the Missouri Pacific Railroad, the locomotive of a passenger train was thrown down a steep bank by a misplaced switch, killing the engineman in the act of jumping from his engine.

On the 10th, at East Albany, N. Y., on the New York Central & Hudson River Railroad, the engine, tender and baggage car of a special express train were thrown from the track.

On the evening of the 10th, on the Kansas Central Railroad at its junction with the Missouri Pacific in Leavenworth, a train jumped the track and went into the ditch.

On the morning of the 11th, near Wilcox, Pa., on the Philadelphia & Erie Railroad, a freight train being too long for the siding was compelled to leave some of its cars on the main track, and consequently left a flagman out to signal the express train for which the freight was waiting. The flagman went into the caboose and went to sleep, having said, it is reported, that "it was too cold, and he wouldn't stay outside for anybody." The express discovered the block when close by, the air brakes were put on, they caught sharp and the coupling broke behind the baggage car, and the engine tore through four box cars loaded with goods, and wrecked them completely. The air brake saved all the coaches, though some of them left the track. The engineman had his arm broken.

On the morning of the 11th, near Chester Station, Va., on the Richmond & Petersburg Railroad, a freight train was thrown from the track by a misplaced switch, and two men who were stealing a ride in a car loaded with lumber were killed, and the engineman was dangerously injured.

On the 11th, near Goshen, N. Y., at the junction of the Erie Railway with the Pine Island Branch, an accident occurred by which eight coal cars were broken up.

On the afternoon of the 11th, a little below St. Joseph, Mo., on the Kansas City, St. Joseph & Council Bluffs Railroad, the engine, tender and baggage car of a passenger train were thrown into the ditch by a broken rail.

On the 12th, near Ackley, Iowa, on the Central Railroad of Iowa, a train consisting of an engine and two caboose cars, while trying to work through snow drifts was thrown from the track by a broken rail.

On the night of the 12th, an east-bound freight train on the North Line of the Lake Shore & Michigan Southern Railway took a siding near Benton, O., to wait for an express to pass. There, it is reported, the engineman went to sleep and dreamed that the express had passed. He seems not to have known that it was a dream, for when he awoke he pulled out and started on, just as the express train, bound west, came in sight. The engineman of the express discovered the freight when close by and applied the air brakes, which arrested the motion so that the shock was but slight. The passenger engine was badly damaged.

On the morning of the 13th, near Acton, Ind., on the Indianapolis, Cincinnati & Lafayette Railroad, the engine and seven cars of a freight train were thrown into the ditch by a broken rail, and the fireman was killed in jumping from the engine. The engineman, who remained on the engine, was not hurt. The rail is said to have been broken by a preceding train.

On the 13th, as a long train was backing on the Ionia & Stanton Branch of the Detroit, Lansing & Lake Michigan Railroad, the caboose ran off the track and one passenger was badly hurt.

On the afternoon of the 14th, near the station in Waltham, Mass., on the Fitchburg Railroad, an express train which was two hours and a half behind time, and moving at a rapid rate, ran through an open switch and into the head of a freight train which was standing on the siding. The engineman of the express saw that the switch was open and put on brakes. The shock was considerable, but the Miller platforms prevented the breaking of the cars, and no one in them was hurt much. The conductor of the passenger train was somewhat hurt in jumping. The two locomotives were badly wrecked.

On the evening of the 14th, while an east-bound passenger train on the Erie Railway was running rapidly near Chester, the engine exploded.

Early on the morning of the 15th, on the New York Division of the Pennsylvania Railroad, one of the trucks under a heavily loaded freight car of the north-bound Millstone way freight broke while the train was between Linden and Rahway, throwing several cars from the track and completely wrecking one. The wrecked car was partly loaded with whisky, and several of the trainmen got drunk while the wreck was being cleared away, and one of them was found in the snow near the wreck badly frozen.

About half-past 5 in the morning on the 15th, near Basket Station, on the Delaware Division of the Erie Railway, eleven cars of a freight train were thrown from the track by a broken rail, and four of them went down the bank. A brakeman was instantly killed.

On the morning of the 15th, one of the wheels broke under the mail car of a train from Boston to Rutland, Vt., while on the Fitchburg Railroad, near Boston.

On the 15th, at Middletown, N. Y., on the up track of the Erie Railway, there was a collision between a milk train and a locomotive, by which the engineman of the milk train was injured and several platforms of the cars crushed.

On the afternoon of the 15th, near Georgesville, O., on the Cincinnati & Springfield Division of the Cleveland, Columbus, Cincinnati & Indianapolis Railroad, some section-hands having run their hand-car upon a side track to get out of the way of an express train, left the switch turned for the side track, so that the express took the side track, and the engine, tender and three cars went into the ditch.

On the night of the 15th, at Canandaigua, N. Y., on the New York Central & Hudson River Railroad, a freight car was blown from a siding to the main track and an express train ran into it.

About the 15th, as a fast express train was running north on the Hudson River Division of the New York Central & Hudson River road, both side rods of the engine were twisted off, knocked a hole in the boiler and flew up through the cab.

On the morning of the 16th, part of an east-bound accommodation train on the St. Louis, Belleville & Southern Illinois Railroad was thrown from the track at Ogle's Station, Ill.

On the morning of the 16th, several cars of an oil train on the Lehigh Valley Railroad ran off the track near Allentown, Pa., breaking one of the tanks so that the oil ran along the track. This caught fire from a locomotive, and several cars were badly burned.

On the morning of the 16th, about four miles west of Baltimore, on the Baltimore & Ohio Railroad, there was a collision between a west-bound gravel train and an east-bound coal train, utterly wrecking both engines, breaking up several cars, and tearing up the track for some distance. The men on the engines saved themselves by jumping.

On the afternoon of the 16th, on the Toledo, Wabash & Western Railway, near Antwerp, Ohio, an entire passenger train ran off the track while running at a high rate of speed, seriously injuring the conductor and a brakeman. The cause is supposed to be the washing away of the road-bed.

About 6 p. m. on the 16th, a passenger train on the New York Division of the Pennsylvania Railroad was thrown from the track by a misplaced switch, near the Chestnut street depot in Newark. The train was run some distance over the ties before it could be stopped, but no damage was done except the smashing of the pilot of the locomotive and the destruction of several telegraph poles.

On the evening of the 16th, between Huntington and Logansport, on the Toledo, Wabash & Western Railway, the caboose car of a freight train ran off and fell over, killing a brakeman who fell under it.

On the night of the 16th, a west-bound passenger train was thrown from the track by a broken rail near Holt, on the Cameron & Kansas City Branch of the Hannibal & St. Joseph Railroad. The engine, baggage car and mail car passed over the break, their springs being broken; the smoking car and two coaches went down a bank about 15 feet and were badly damaged, and four passengers were slightly hurt.

Early on the morning of the 17th, a collision occurred between two coal trains on the Boonton Branch of the Delaware, Lackawanna & Western Railroad, near Kingsland, N. J. Both locomotives and a number of coal cars were wrecked, blocking the track for several hours, ond three brakemen were badly bruised. There was a thick fog at the time.

On the morning of the 17th, near Lanesville, Conn., on the Housatonic Railroad, the baggage car and one coach of a special passenger train were thrown from the track by the washing away of the road-bed under the frozen surface, injuring the baggage master.

Early on the morning of the 17th, some cars of a south-bound passenger train on the Housatonic Railroad left the track where the road-bed had been washed away, but without injury to any person.

On the morning of the 17th, near Dubbs' Mills, Pa., on the East Pennsylvania Railroad, the track suddenly sunk *about fifteen feet*, it is reported, under an express train, breaking the legs of two men who were repairing track.

On the 17th, about noon, the sleeping car of an up train from Pittsburgh on the Allegheny Valley Railroad was thrown from the track by a broken rail and fell into the river near Scrub Grass, Pa., killing two passengers, injuring two seriously and three more slightly, among the latter Superintendent Hepburn, of the Oil Creek Railroad.

On the 17th, near Steeleville, Ill., on the Chester & Tamaroa Railroad, a mail car, caboose and three coal cars of a mixed train were thrown from the track and into the ditch, blocking the track about a day.

On the 17th, a freight train on the Chicago & Northwestern Railway was thrown from the track by a broken rail, near Bertram, Iowa, and ten cars of stock went into the ditch.

On the 17th, part of a freight train on the La Crosse Division of the Milwaukee & St. Paul Railway ran off the track near Tomah, Wis.

On the afternoon of the 17th, as an ore train on the Clove Branch Railroad, at its junction with the Dutchess & Columbia, was passing over a frog, one of the trucks left the track and seven cars were thrown off.

On the afternoon of the 17th, as an express train on the St. Paul & Sioux City Railroad was about to cross the bridge over the Mississippi at St. Paul, one of the wheels in the forward truck of a passenger car broke, and the truck ran off the track, delaying the train an hour and a half.

On the afternoon of the 17th, on the New York Central & Hudson River Railroad, a locomotive truck of a south-bound passenger train broke while approaching Greenbush, N. Y., at a slow rate, and the engine and baggage car were thrown from the track.

On the afternoon of the 17th, near Richmond, Mich., on the Chicago & Michigan Lake Shore Railroad, a south-bound passenger train was thrown from the track and five passengers injured. A passenger car went down a bank 30 feet high, making a complete revolution in its descent, and landing right side up. The train was moving about seven miles an hour on a down grade, at a point where trains are not permitted to run any faster.

On the evening of the 17th, the locomotive, baggage car, passenger cars and six freight cars of a mixed train on the Des Moines Valley Railroad were thrown from the track by a broken rail at Grand Junction, Iowa, delaying the train eight hours.

On the night of the 17th, a north-bound mail train on the St. Louis & Iron Mountain Railroad ran into a freight train which was standing on the track near Quarantine, Mo. The mail was some hours late, but the cause of the collision is said to have been the neglect of a brakeman to flag the mail train. There was some damage to the freight cars and the mail engine.

On the morning of the 18th, on the Hudson River Division of the New York Central & Hudson River Railroad, about two miles north of Hyde Park, a freight train ran off the track.

About 8 o'clock on the morning of the 18th, the tender of the mail train bound west on the Morris & Essex Division of the Delaware, Lackawanna & Western Railroad was thrown from the track by the breaking of an axle, near the bridge over the Morris Canal in Newark, N. J. The train was delayed about an hour, but very little damage was done.

On the afternoon of the 18th, near Palmyra, Mo., on the Hannibal & St. Joseph Railroad, one coach and a sleeping car of an east-bound express train were thrown from the track by a broken rail and went into the ditch.

On the morning of the 18th, at Cavendish, Vt., on the Rutland Division of the Vermont Central Railroad, eleven cars of a freight train were thrown from the track by the breaking of an axle.

On the morning of the 20th, a train on the Saugus Branch o the Eastern Railroad ran into a load of hay which was crossing the track at the time near Linden Station, Mass., and the engine was thrown from the track.

On the 20th, about noon, a coal train on the Northern Central Railway jumped the track near Watkins, N. Y., and was dragged over the ties three miles to the next station, when two more cars left the track at a frog and the mishap was discovered. The car passed over two bridges and three culverts after leaving the rails.

On the 20th, on the Northern Pacific Railroad, near Oak Lake, Minn., two engines, while butting on different sides of a hard-headed snow drift, suddenly made way through it unexpectedly, and came together with terrific force, utterly demolishing both snow plows and engines, but injuring no one.

On the morning of the 21st, the express car, baggage car, and one coach of a west-bound passenger train on the Erie Railway were thrown into the ditch at Nunda, N. Y., on account, it is reported, of a defective wheel.

About 5 o'clock on the morning of the 21st, an east-bound express train on the Indianapolis, Bloomington & Western Railway encountered a broken rail near Champaign, Ill., by which two coaches were ditched and two passengers slightly injured.

On the 21st, a few miles west of Wheeling, W. Va., on the Baltimore & Ohio Railroad, a driving-wheel tire of an engine drawing a freight train broke, and the engine was thrown squarely across the track.

On the 21st, near White Hall, N. J., on the Boonton Branch of the Morris & Essex Division of the Delaware, Lackawanna & Western Railroad, a freight train of 54 cars was thrown from the track by a misplaced switch, and many of the cars were completely wrecked.

On the night of the 21st, at La Grange, O., on the Cleveland, Columbus, Cincinnati & Indianapolis Railroad, as a south-bound passenger train was coming out of a riding, the rear

truck of a sleeping car was thrown from the track by a broken frog, a sleeping car behind it left the rails and was dragged with the wheels on the ties on one side and on the bank on the other, while a third sleeping car, at the rear of the train, went down the bank and turned over nearly. The motion of the train being very slow, no great damage was done.

On the night of the 21st, two miles east of Wabash, Ind., the sleeping-car and rear coach of an east-bound passenger train on the Toledo, Wabash & Western Railway were thrown from the track by a broken rail, and down a bank ten feet high and broken to pieces, injuring the conductor and one passenger seriously, and the baggage master and nine passengers slightly.

On the morning of the 22d, near Wells Village, Me., on the Portland Extension of the Boston & Maine Railroad, a construction train, with a box car at the rear containing fifty or more workmen, while backing down the track encountered a plank which had fallen across the track from a supply train. This threw the box car from the track and upon its side, injuring about 20 men, one of them fatally.

On the 22d, at Monmouth Junction, N. J., on the New York Division of the Pennsylvania Railroad, a number of cars of a freight train jumped the track and blocked the road for some time.

On the 22d, at Bridesburg, Pa., on the New York Division of the Pennsylvania Railroad, several cars of a freight train were thrown from the track, blocking the road for some time.

About 6:30 o'clock on the evening of the 22d, the front truck of the tender of a passenger train on the Morris & Essex Division of the Delaware, Lackawanna & Western Railroad left the track at a frog, just as the train was entering the eastern end of the Bergen Tunnel. The train was moving slowly at the time, and no damage was done except the breaking of a spring on the tender truck and the detention of trains for nearly two hours.

On the evening of the 22d, a locomotive on the North Pennsylvania Railroad exploded at American and Norris streets, Philadelphia, killing one man and injuring two others, one of the latter being the engineman, who was slightly scalded.

On the night of the 22d, at Comstock, Iowa, on the Des Moines Valley Railroad, the locomotive and nine cars of an east-bound freight train were thrown from the track and into the ditch. "A bent switch-bar" is assigned as the cause.

On the 23d, a north-bound passenger train of the Illinois Central Railroad, being about four hours behind time (and the road being so badly blocked with snow at the time that most trains were laid up and none were on time) ran into the rear of a Michigan Central passenger train near the Twenty-second street depot in Chicago, knocking a sleeping car from its rear truck, and staving in the engine's smoke-stack. It is reported that the use of the Westinghouse brake is all that prevented a terrible crash.

On the 23d, up and down freight trains on the Indianapolis, Bloomington & Western Railway came in collision at Covington, Ind., and one engine and a caboose were destroyed.

On the night of the 23d, two locomotives which were hauling an express train through snow drifts on the Erie Railway were thrown from the track and into a stream at Deposit.

On the night of the 23d, during the great snow blockade, four locomotives attached to an east-bound freight train on the Indianapolis, Bloomington & Western Railway, jumped the track on entering a switch near the depot in Champaign, Ill., and ran into a train of freight cars which was standing on the side-track. The engines were all badly damaged and the freight cars were totally wrecked.

On the morning of the 24th, near Ashland, Wis., on the Wisconsin Division of the Chicago & Northwestern Railway, the road being blocked with snow at the time, a south-bound express train was thrown from the track by a broken rail, and three coaches went into the ditch.

On the morning of the 24th, as an engine and a baggage car were backing down from the engine house to the depot in Burlington, Iowa, on the Burlington, Cedar Rapids & Minnesota Railroad, a rail broke and the baggage car rolled down the bank of the Mississippi till it lodged on its frozen surface. A man who was in the car was slightly injured.

On the morning of the 24th, near Hilton, Ill., on the Toledo, Peoria & Warsaw Railway, a west-bound passenger train struck a broken rail, and the cars were thrown off.

On the 24th, a few miles west of Urbana, Ill., on the Indianapolis, Bloomington & Western Railway, the rear sleeping car of a train having broke loose and stuck in the snow, an engine was sent after it. This engine ran into the ditch and was disabled.

Another engine having been sent on the same errand, and being engaged in pulling the car eastward, an east-bound freight car ran into the end of the car and broke in one end of it, while the freight engine tumbled into the ditch.

On the same day and road, 14 miles east of Urbana, Ill., a train of freight cars ran off the track and into the ditch.

On the 24th, as a train with two engines was trying to go through a snowdrift on the Toledo, Wabash & Western Railway at Elvaston, Ill., both locomotives were thrown the track and somewhat damaged.

On the afternoon of the 24th, near Willow Springs, Ill., on the Chicago & Alton Railroad, a part of an accommodation train was thrown from the track by a broken rail, which was not discovered, however, and the train was re-railed, and passed on, and

A little later, ten cars of a coal train which was following the accommodation at a rapid rate jumped the track at the same place, damaging the cars badly. The broken rail was still undiscovered, and

Shortly after, a relief train composed of two engines and a caboose, sent to assist the coal train, ran off at the same place. The cause of the three accidents was then discovered. There was abundant snow at the time.

On the night of the 24th, near Middlefield, Mass., on the Boston & Albany Railroad, as an east-bound freight was approaching a bridge over the Westfield River, a brake broke and fell under the third car of an east-bound freight and threw that car from the track about 50 feet west of the bridge. Twenty cars of the train then passed the bridge safely, but the last three struck the stringers under the rails and shoved them aside, so that the cars fell through and two men in one of them were badly hurt.

Just at that time, a west-bound train ran upon the bridge and the engine and five cars went through and the bridge went down.

On the night of the 24th, between River Forest and Oak Park, on the Galena Division of the Chicago & Northwestern Railway, an east-bound express train was thrown from the track, and two sleeping cars much damaged. A brakeman's leg was broken.

On the night of the 24th, a few miles east of Mechanicsburg, Ohio, on the Cleveland, Columbus, Cincinnati & Indianapolis Railroad, the baggage car and one coach of a passenger train were thrown from the track by a broken frog, and the baggage car turned completely over. One passenger was severely hurt.

On the morning of the 25th, as a passenger train on the Troy & Boston Railroad was entering Troy (being half an hour late) it was turned by a misplaced switch upon a branch track of the Rensselaer & Saratoga road and ran into a freight car which was standing in its way, damaging the engine slightly and breaking the platform of the baggage car. A man who was standing on the platform was severely injured.

On the morning of the 25th, about 1 o'clock, as a freight train on the Pittsburgh, Fort Wayne & Chicago Railway was standing on the track at Alliance, O., four flues of an engine exploded, fatally scalding the fireman.

On the morning of the 25th, an accomodation train on the Baltimore & Ohio Railroad ran through a misplaced switch over a siding and down a bank beyond into the Youghiogheny River, about two miles east of Connellsville, Pa.

On the morning of the 25th, at Maywood, Ill., on the Galena Division of the Chicago & Northwestern Railway, the switches were set to turn an east-bound way train, then due, from the down to the up track, in order that it might take on two coaches with passengers from a side-track, as usual. The train approaching, however, was not the way train expected, but an express train then more than an hour over-due, of whose position the station agent had no information. The express was not intending to stop, and running over the switch at full speed the tender jumped the track, and when the engine struck the frog between the up track and the siding the frog broke, the engine left the track and broke loose from the tender, and ran partly on the siding until it struck the waiting coaches, crashing half way through one of them, and burying a family consisting of a man, wife and three children in the ruins, the man only being severely hurt, the others slightly. It is said that the man's boots were torn off and found caught in the bars of the cow-catcher! It is reported that there was no telegraph office at Maywood.

On the 25th, at the crossing of the Chicago & Northwestern and the Milwaukee & St. Paul roads at Watertown Junction, Wis., a south-bound freight train of the former road ran into one west-bound on the latter, damaging the Northwestern engine and breaking up three of the Milwaukee cars.

On the 25th, a freight train backing into the depot of the Detroit & Milwaukee Railroad in Detroit ran off the track and knocked down one of the supports of the roof, so that a large part of the roof fell down, slightly injuring four men. The damage is said to be about $4,000.

On the 25th, as a passenger train on the Rockford, Rock Island & St. Louis Railroad was passing a switch leading to a coal-mine track at Coal Valley, Ill., the switch-rod broke and the locomotive, tender and forward truck of the baggage car having passed safely, the rear truck of the baggage car took the coal track and this car was turned on its side between the two tracks, killing the baggageman and one other person. The coaches took the coal track and ran on it for some distance.

On the evening of the 25th, near Chelsea, Mich., on the Michigan Central Railroad, two coaches of an east-bound express train were thrown from the track by a broken brake-beam falling under a track, and two passengers were badly hurt.

On the morning of the 26th, as an east-bound express train on the Hannibal & St. Joseph Railroad was passing the switch at Bear Creek Station, Mo., running about 20 miles an hour, a connecting rod broke, and the ends on the drivers broke one side of the cap and made a hole in the boiler from which hot steam filled the cab and drove out the engineman and fireman, who were unable to call brakes or shut off until the steam had run down.

On the night of the 26th, nine cars of a south-bound passenger train on the Illinois Central Railroad were thrown from the track by a broken rail about three miles from Manteno, Ill., injuring slightly three passengers, and badly wrecking some of the cars.

On the night of the 26th, near Butler, Ill., on the Indianapolis & St. Louis Railroad, a freight train was wrecked by a broken rail, and four cars loaded with stock were badly broken up.

On the afternoon of the 27th, about six miles east of Indianapolis, on the Cincinnati & Indianapolis Junction Railroad, a passenger car was thrown down a bank six or seven feet by a broken rail, lodging on its side badly broken. Six passengers were badly hurt.

On the 27th, a north-bound express train on the Illinois Central Railroad was thrown from the track by a broken axle, at Kankakee, Ill., very little damage being done.

On the night of the 27th, on the Michigan Central Railroad, an east-bound express train ran into the head of a west-bound freight, which was backed upon a side track, except the engine and one or two cars which remained upon the main track. Both engines and several cars were badly damaged.

On the night of the 27th, a special train on the Connecticut River Railroad ran off the track at Holyoke, Mass., killing a youth who was acting as brakeman.

About 4 o'clock on the morning of the 28th, at Hohokus, N. J., on the Erie Railway, a truck broke under the tender of an express train, blocking the track and delaying trains until afternoon.

On the morning of the 28th, there was a collision between two freight trains on the Indianapolis, Bloomington & Western Railway, at Covington, Ind., causing considerable delay.

On the 28th, a west-bound freight train on the Great Western Railway of Canada broke a rail near Ingersoll, Ont., and had its engine thrown from the track. This engine was abandoned in the ditch, and

A few hours later, the same train with two engines hauling it ran into the rear of a freight train, utterly wrecking the caboose.

On the 28th, there was a butting collision between a freight and a mixed train on the New London Northern Railroad between Palmer and Three Rivers, Mass., by which a telegraph operator was killed, a passenger and three section men injured, and both engines badly broken. It is reported that the responsibility for the accident rested with the man who was killed, who had left his own work in the charge of an incompetent person.

On the afternoon of the 28th, as a passenger train on the Erie Railway was crossing Big Flats Bridge, an axle broke under the tender, and the truck left the rails, broke some of the timbers, threw the baggage car from the rails and dragged it and the rest of the cars (which kept the rails) safely over the bridge.

On the 28th, near La Grange, Ind., on the Grand Rapids and Indiana Railroad, a freight train ran off the track, causing the death of a brakeman.

On the afternoon of the 28th, as a mixed train on the Missisquoi Railroad was crossing a trestle near North Sheldon, Vt., the brake-beam fell under the truck of a freight car, and that truck, being thrown from the track, swept away the ties on the trestle, and two freight cars went over the trestle, and a baggage and mail car and a passenger car left the rails, but not the trestles.

On the night of the 28th, part of a passenger train on the Indianapolis, Bloomington & Western Railway was thrown from the track near Tremont, Ill., and one person was badly hurt.

About 10 o'clock on the morning of the 29th, an east-bound passenger train on the Morris & Essex Division of the Delaware, Lackawanna & Western Railroad had the tender thrown from the track while passing over the Newark Meadows by the breaking of the flange of one of the wheels of the forward truck.

On the morning of the 29th, between Hollis and Lower Peoria, Ill., on the Peoria, Pekin & Jacksonville Railroad, a broken rail threw into a ditch eight box cars and a caboose full of passengers of an accommodation train. It is reported that *five* broken rails were found, over which the engine and one car had passed safely—if, indeed, these rails were not broken by the derailed trucks.

On the morning of the 29th, near Assumption, Ill., on the Illinois Central Railroad, the baggage car, mail and express car and one coach of a north-bound passenger train were thrown from the track down the bank by a broken rail, and the mail agent and the newsboy were slightly injured.

On the 29th, six cars of an east-bound freight train on the Missouri Pacific Railroad were thrown from the track by a broken rail near Meramec, Mo., and two of them went into the ditch. The rail which broke was a new one and laid last October.

On the 29th, near El Paso, Ill., on the Illinois Central Railroad, the engine of a passenger train was thrown into the ditch by a broken rail, and

Another engine having been attached and having started with the train, the ladies' car was thrown down the bank by the same broken rail.

On the afternoon of the 29th, between Poultney and Middle Granville, Vt., on the Rensselaer & Saratoga Railroad, as a mixed train was passing over a high bank, a car loaded with rye "suddenly broke down," and left the track, making bad work with the rails and ties. The couplings held, however, and nothing went over the bank.

Early on the morning of the 30th, ten cars of coal went off the track of the Illinois Central Railroad a little south of the bridge over the Illinois in LaSalle, Ill.

On the 30th, near Wood's Station, Ind., on the Cincinnati & Indianapolis Junction Railroad, two passenger cars were thrown from the track by a broken rail and came to a stand about 40 feet from the track. One passenger was badly hurt.

On the 30th, a freight train on the Jeffersonville, Madison & Indianapolis Railroad was thrown from the track by a broken flange near Edinburg, Ind.

On the morning of the 30th, a wheel broke under one of the cars of a freight train on the Philadelphia, Wilmington & Baltimore Railroad as it was crossing Gunpowder Bridge, and the end of the car dropped upon the track, causing several hours' delay.

On the morning of the 30th, a freight train on the Indianapolis, Cincinnati & Lafayette Railroad was thrown from the track near Muddy Creek, Ind.

On the 30th, two cars of a freight train on the Indianapolis, Cincinnati & Lafayette Railroad were thrown from the track near Fall Creek Bridge, blocking the road some hours.

On the 30th, a passenger train on the Cherokee Railroad ran off the track near Cartersville, Ga., and some of the passengers were slightly bruised.

On the 30th, a freight train loaded with hogs on the New York Central & Hudson River Railroad ran off the track at East Albany, N. Y., damaging the locomotive, five cars and a number of hogs.

On the 30th, a train of coal cars ran into some ore cars which were standing at the Lebanon Valley depot in Harrisburg, Pa., and knocked several from the track and upon the depot plat-

form. The ore cars, it is reported, should have been further down the track, so as to clear a switch entrance for the coal cars.

On the afternoon of the 30th, near Ischua, N. Y., on the Buffalo, New York & Philadelphia Railroad, a south-bound passenger train was thrown from the track by a broken switch, damaging the cars considerably.

On the evening of the 30th, about four miles north of New Haven, Conn., on the New Haven & Northampton Railroad, an express train was thrown from the track by a broken rail, and the rear car went down an embankment, turned over, and was crushed to pieces. Five passengers were severely and eleven slightly injured. The car caught fire from the stoves, but was soon put out.

On the morning of the 31st, near Bridgeport, Ind., on the St. Louis, Vandalia, Terre Haute & Indianapolis Railroad, a long train of empty coal cars was piled up by a broken rail, the engine and three rear cars escaping.

On the afternoon of the 31st, about 10 miles east of Waverly, Tenn., on the Nashville & Northwestern Railroad, the sleeping car and one coach at the rear of a west-bound passenger train were thrown from the track by a broken rail, and the sleeping coach turned completely over, while the other fell on its side. Both cars caught fire, which was put out by a few pails of water. Three of the train men and three passengers (there were only two in the sleeping car) were injured.

Near the close of the month, on the St. Paul & Sioux City Railroad, a west-bound wild engine and an east-bound regular passenger train met in collision between Mankato and Lake Crystal, Minn., as they were running rather slowly around a sharp curve. The engines were badly wrecked, and the engineman and a brakeman of the regular train were badly hurt. The cars did not leave the track. The telegraph operator at Lake Crystal had been ordered to hold the passenger train there until the wild engine passed, but this he neglected to do.

On the Houston & Texas Central Railroad near the close of the month a train was wrecked in some way and several cars destroyed.

(The following, reported in a Knoxville paper, had no dates attached in the report:)

The engine and four loaded cars of a freight train on the Atlantic, Mississippi & Ohio Railroad broke through a bridge over the Roanoke River between Salem and Big Spring, Va., injuring the engineman severely. On the same road a construction train was wrecked by running into a rock slide, and a workman was killed in jumping from the train. A train following the above ran into the wreck, breaking up the rear cars. Thirteen cars of a freight train were thrown from the track at Zollicoffer, and five train hands killed. Several cars were ditched at Owen's Tank, and a trainman badly hurt. Six cars of a freight train were thrown from a trestle on the Memphis & Charleston road by a broken wheel.

The number of accidents reported above is 178, larger by one-third than we have ever had to report before for a single month.

They may be classified as to their nature and causes as follows:

Derailments.	
Unexplained	43
Broken rail	41
Misplaced switch	9
Broken wheel, flange or tire	8
Washing out of road-bed	5
Broken axle	4
Broken or defective switch or switch-bar	4
Snow or ice	4
Broken truck	3
Fall of brake or brake beam	3
Accidental obstruction	3
Broken bridge	2
Broken frog	2
Broken car	1
Running fast into siding	1
Ox falling from car	1
Rail removed for repairs	1
	— 131
Collisions.	
Rear collisions	15
Head collisions	13
Crossing collisions	1
Unknown	4—33
Explosion of boiler or flues	3
Broken wheel (no derailment)	3
Broken connecting rod "	2
Broken driving axle "	1
Unknown	2
Total	178

By these 178 accidents 40 persons were killed and 199 injured more or less severely—an unusually small proportion of fatal injuries. Of the whole number 22 accidents caused death and 45 others injuries, so that 111, or five-eighths of the whole, caused no injury to persons.

An examination of the causes of the accidents shows that 55—nearly one-third of the whole number—were occasioned by defects or failures in permanent way, and of these no less than 41 were the breaking of rails—a number nearly equal, we think, to all the cases of broken rails for the eleven months previously, though there were 18 in December. The extraordinarily cold weather and the numerous heavy snow storms had doubtless much to do with this, it being very difficult to keep track in condition under such circumstances, the use of heavy snow plows impelled with all the force of two, three or four engines subjecting rails to unusual shocks, while the snow makes it difficult or impossible to discover defects. Defects and failures of rolling stock caused 28 accidents, including the three explosions. Forty-three, including the 33 collisions, were caused by errors in running the trains. Eight were caused by obstructions of some kind on the track, and 44, as we have seen, are unexplained.

It is perhaps worth noticing that while there was an average of 5⅓ accidents daily, they were not at all evenly distributed among the different days of the month; but we have none reported for the 19th, only one for the 5th, and ten for the 2d, fourteen for the 17th, fourteen for the 24th, and eleven for the 30th. Sundays being the days when fewest trains are run, we should expect to see a small average for this day; and it is so, indeed, there having been but one accident on the first, two on the second, none on the third, and three on the fourth Sunday of the month—not quite one-fourth the average of the other days.

For the twelve months ending with January our record stands as follows:

	No. of Accidents.	Killed.	Injured.
February	21	18	128
March	27	3	67
April	22	13	32
May	27	9	33
June	44	63	114
July	31	35	66
August	63	15	49
September	71	24	104
October	90	29	102
November	103	37	114
December	112	42	133
January	178	40	199
Totals	789	328	1,141

As we have repeated so often, our sources of information were more imperfect before July than they have been since, and a large part of the apparent increase in accidents not causing deaths is doubtless due to that fact.

We do not know how we can say anything more impressive than the formidable list of accidents given above. The winter, and the last month, especially, have doubtless been very trying on roads, and to the running of trains. The frequent and very deep snows have not only been an obstacle in themselves, but they have made inevitable that irregular running of trains which is one of the most fruitful occasions of accidents. Then, too, train men at such times are likely to be overworked, and, in the very severe weather, those employees who think more of their comfort than their duty (and we find such men frequently in all occupations) are likely to be less than usually vigilant. But, after all, we believe that no manager can read this record and say that most of these accidents, even in the existing condition of things, could not have been avoided.

General Railroad News.

ELECTIONS AND APPOINTMENTS.

—T. E. Clark having resigned the position of Train Dispatcher and Superintendent of Telegraph for the St. Paul & Sioux City and Sioux City & St. Paul railroads, W. H. Drake has been appointed to fill the vacancy, with headquarters at St. Paul, and entered upon his duties February 1, 1873.

—General Order No. 2, from Mr. James Sedgley, the General Master Mechanic of the Lake Shore & Michigan Southern Railway, announces the following appointments: Mr. W. L. Wallace is appointed Master Mechanic of the Buffalo Division, *vice* Mr. B. H. Kidder, resigned; office and shop at Buffalo, N. Y. Mr. J. M. Sanborn is appointed foreman of engine house at Air Line Junction, Toledo, *vice* Mr. W. L. Wallace, transferred. These appointments took effect February 1, 1873.

—A circular from the Superintendent's office of the Chicago, Burlington & Quincy Railroad announces that Mr. George Chalender has been appointed General Master Mechanic, and will have charge of the Locomotive Department of that road and its leased lines, with office at Burlington, Ia. Mr. Ch lender has for some years been Master Mechanic of the Burlington & Missouri River Railroad.

—Mr. A. L. Dunbar, Acting Superintendent of the First and Second Divisions and Franklin Branch of the Atlantic & Great Western Railroad, will be hereafter Division Superintendent of the Second Division and Franklin Branch. Mr. J. T. Odell has been appointed Division Superintendent of the First Division.

—Mr. B. H. Kidder has been appointed General Master Mechanic of the Atlantic & Great Western Railroad, in place of S. Van Vechten, resigned. Mr. Kidder has been Master Mechanic of the Buffalo Division of the Lake Shore & Michigan Southern Railway.

—John B. Thorndike has been appointed State Director for Massachusetts in the Boston, Hartford & Erie Railroad Company; Moses Kimball, of Boston, has been re-e ected State Director of the Boston & Albany, and Erastus P. Carpenter, of Foxboro, Mass., is chosen to the same position in place of Avery Plumb, of Boston.

—Governor Beveridge, of Illinois, has nominated to the State Senate as Railroad and Warehouse Commissioners, S. H. McCrea, of Chicago; John Stillwell, of Lexington; W. H. Robinson, of Wayne County. There is great opposition to these nominations.

—Frank E. Clappert, for 19 years in the service of the Illinois Central Railroad Company, much of the time as foreman of the engine house at the Weldon shops in Chicago, has accepted a similar position on the Houston & Texas Central Railroad. On the 31st ult. his fellow employees presented him with a purse, as a testimonial on parting with him.

The newly-elected directors of the Great Western Telegraph Company have chosen the following officers: President, Joshua Stark, Milwaukee; Vice-President, James E. Boyd, Omaha, Neb.; General Superintendent, A. H. Bliss, Chicago; Secretary and General Agent, Orville D. Bond, Chicago; Treasurer, Melvin Tabor, Chicago. The Executive Committee are: Joshua Stark, Milwaukee; John L. Bennett, Chicago; A. H. Bliss, Chicago; R. B. Frary, Illinois, and D. C. Farrell, Peoria, Ill.

—The stockholders of the Connecticut Central Railroad met at East Windsor Hill, Conn., February 3, and elected as directors: George Beach, of Hartford; John W. Phelps, of Springfield; Omar Pease, of Shakers; M. H. Allen, Francis Gowdy and John M. Stiles, of Broad Brook; Lemuel Stoughton, W. S. Osborne and Osman Stedman, of East Windsor.

—William S. Slater was, on the 7th, elected President of the Providence & Worcester Railroad Company, *vice* E. P. Mason, who declined re-election.

—Mr. Charles L. Kimball, late Superintendent of the Dutchess & Columbia Railroad, has been appointed General Superintendent of the New York, Boston & Montreal road.

—J. P. Kidder has been chosen President; W. Tripp, Vice-President; J. A. Potter, Secretary and Treasurer; George Stickney, Engineer, and J. P. Kidder, W. Tripp, W. A. Burleigh, M. K. Armstrong, G. Stickney, W. P. Lyman and J. A. Potter, directors of the Dakota & Northwestern Railroad Company.

—At the annual meeting of the Milwaukee Iron Company, January 22, Captain E. B. Ward was chosen President; Alexander Mitchell, Treasurer; J. J. Hagerman, Secretary and General Superintendent, and E. B. Ward, Alexander Mitchell, J. H. Van Dyke, O. W. Potter and J. J. Hagerman, directors.

—At the annual meeting of the Belvidere Delaware Railroad Company, at Trenton, N. J., February 5, the following board of directors was chosen for the ensuing year: Ashbel Welch, George B. Roberts, Josiah Bacon, Thomas A. Scott, John M. Kennedy, A. J. Derbyshire, George M. Robeson, Charles Sitgreaves, Lewis Perrine. Messrs. Derbyshire, Robeson, Sitgreaves and Perrine are new directors, replacing Washington Butcher, H. J. Lombaert, E. Smith and J. B. Myers. The road is leased by the Pennsylvania Railroad Company.

—At the annual meeting of the Flemington Railroad Company, at Trenton, N. J., February 5, the following gentlemen were chosen directors for the ensuing year: Ashbel Welch, Charles Bartles, William P. Emery, Alexander Wurts, John C. Hopewell, Robert F. Stockton, Benjamin Fish, Thomas B. Fidler, Samuel Kelly. These are all re-elections.

—The Columbus & Xenia Railroad Company has elected the following board of directors: P. W. Huntington, J. R. Swan, Robert Neil, Henry C. Noble, H. J. Jewett, J. C. Butler, P. C. Casselly, R. A. Harrison, A. Hivling, J. Hutcheson, Baldwin Gwynne, H. Hanna.

—At the annual meeting of the Galveston, Houston & Henderson Railroad Company at Galveston, Tex., Jan. 29, the following board of directors was chosen: T. W. Pierce, of Boston, Mass.; A. P. Lufkin, William R. Smith, W. L. Moody, John Wolston, John Seadly, E. S. Wood, W. J. Hutchins, J. M. Brandon, Leon Blum, George H. Alford, of Galveston. The following officers were chosen: President, T. W. Pierce; Vice-President, John Seadly; Superintendent, Geo. B. Nichols; General Freight and Ticket Agent, H. B. Andrews; Secretary and Treasurer, J. E. Fisher. Mr. Alford takes the position on the board of J. P. Davie. The rest are re-elections.

—The Union Steamboat Company, of Buffalo, has chosen the following board of directors: Peter H. Watson, Samuel L. M. Barlow and Wm. Butler Duncan, of New York; Elisha A. Buck and Henry L Lansing, of Buffalo. Mr. Watson is the President of the Erie Railway, Mr. Barlow is Chairman of the Executive Committee of the Erie Board, and Messrs. Duncan and Lansing are directors.

—Mr. James B. Hodgskin, late Treasurer, has been chosen Vice-President of the Atlantic & Great Western Railroad Company, in place of General George B. Wright, resigned.

—Mr. J. H. Parsons has been appointed Superintendent of the Western Division of the Lake Shore & Michigan Southern Railway, in place of John Desmond, resigned. His headquarters will be in Chicago. Mr. J. J. Charlesworth has been appointed Superintendent of the Lansing Division of the same road, with headquarters at Albion, Mich.

—Gov. Joseph E. Brown was re-elected President of the Western & Atlantic Railroad Company at a meeting of the directors held at Atlanta, Ga., February 6. Colonel E. W. Cole, formerly General Superintendent, was chosen Vice-President, and General William McRae, late General Superintendent of the Macon & Brunswick road, was appointed General Superintendent.

—At the annual meeting of the Adddison Railroad Company, held at Rutland, Vt., January 30, the following board of directors was elected: E. A. Birchard, Brandon; Gasca Rich, Shoreham; W. T. Foot, Port Henry; Lawrence Barnes, Burlington; John B. Page, Rutland. At a subsequent meeting of the directors, John B. Page, of Rutland, was unanimously elected President.

—At the annual meeting pf the Rutland Railroad Company, held at Rutland, Vt., January 30, Edwin A. Birchard, of Brandon; Peter Butler, George B. Chase and Jacob Edwards, of Boston; John B. Page, of Rutland; James H. Williams, of Bellows Falls, and James W. Hickok, of Burlington, were elected directors for the year ensuing. The directors subsequently elected Governor John B Page President of the company. Messrs. Edwards and Hickok are new directors, replacing L. Barnes, of Burlington, and D. N. Skillings, of Boston.

—The Toledo & St. Louis Air Line Company, formed by the consolidation of the Toledo, Thorntown & St. Louis and the St. Louis, Shelbyville & Detroit Companies, has chosen the following board of directors: Ransom Gardner, T. S. Sprague, H. E. McNeil, L. A. Danby, of Michigan; G. D. Chaffee, L. B. Stevenson, J. W. Lloyd, S. B. Blackwell, D. W. Marks and I. Patterson, of Illinois; S. C. Wilson, M. B. Garter, J. H. Cable, Isaac Porter, J. C. Silvers, G. A. Dent, James Brownse, A. G. Wells, of Indiana, and A. V. Rice, of Ohio. The board organized by the choice of the following officers: President, Ransom Gardner, of Kalamazoo, Michigan, in place of Colonel Sprague, who declined the office; Vice-President, G. D. Chaffee, of Shelbyville, Ill.; Secretary, H. S. McNeil, of Detroit, Mich. G. B. Wendling, of Illinois, was appointed Attorney for the road in that State; C. Cowgil, of Wabash, Attorney for Indiana, and M. R. Waite, of Toledo, Ohio, the Attorney for the Eastern Division.

TRAFFIC AND EARNINGS.

—The earnings of the Central Pacific Railroad for the month of January were: 1873, $852,860; 1872, $592,223; 1871, $534,498; increase 1873 over 1872, $260,637, or 44 per cent.; increase 1873 over 1871, $318,362, or 59 per cent.

—The earnings of the Pacific Railroad of Missouri for the month of December were: 1872, $260,404; 1871, $289,810; decrease, $29,406, or 10¼ per cent. The earnings for the year were: 1872, $3,564,873; 1871, $3,558,730; increase, $4,143, or 0¼ per cent. The earnings per mile for the year were at the following rate: 1872, $7,564; 1871, $10,025; decrease, $2,461, or 24½ per cent.

—The earnings of the St. Louis & Southeastern Railway (consolidated) for the third week in January were $21,190.45, showing an increase of $2,194 13 over the corresponding week in December. The ice-blockade in the Ohio River still interrupts traffic.

—The earnings of the Kansas Pacific Railway for the fourth week in January were: from passengers, $16,926.35; freight, $23,937.42; mails, $2,055.32; total, $42,919.09. Of this amount, $3,883.29 was for transportation of troops, mails and government freight.

—The earnings of the Toronto, Grey & Bruce Railway for the year 1872 were: from passengers, $52,391.41; freight, $86,-082.60; mails and sundries, $9,222.06; total, $147,696.97. These earnings were at the rate of $1,698 per mile for the year. The road is of 3 feet 6 inches gauge.

—The earnings of the Toronto & Nipissing Railway for the year 1872 were: from passengers, $43,078.40; freight, $63,-046.73; mails and sundries, $4,608.12; total, $110,733.25. This is at the rate of $1,334 per mile for the year. The road is of 3 feet 6 inches gauge.

—The following companies have thus far reported earnings for January:

	1873.	1872.	Increase.	Decrease.	P.c.
Central Pacific	$852,860	$592,223	$260,637	...	44
Erie	1,316,831	1,333,310	....	$16,479	1¼
Kansas Pacific	150,567	....	....	....	..
Marietta & Cincinnati	170,043	152,577	17,466	....	11½
Ohio & Mississippi	277,776	273,024	4,752	....	1¾
St. Louis & Southeast'n	83 126	64,397	18,729	....	29⅛
Chicago & Alton	352,538	372,316	....	19,778	5¼
Clev., Col., Cin. & Ind.	358,612	340,791	17,821	....	5¼
Lake Shore & Mich S'n	1,412.368	1,276,150	136,218	....	10⅝
Toledo, Wabash & W'n	370,490	439,780	....	69,490	15¾

—The Saginaw (Mich.) *Courier* gives the following statement of the lumber traffic of the railroads centering at that place during 1872: On the line of the Flint & Pere Marquette Railroad there was cut 49,850,500 feet of lumber and 96,000,000 shingles; on the Jackson, Lansing & Saginaw, 23,500,000 feet of lumber and 6,500,000 shingles; on the Saginaw Valley & St. Louis Railroad, 14,000 000 feet of lumber and 11,500,000 shingles. This is but a small portion of the business, as the cut along the lake shore and the Saginaw River and tributaries was 785,819 000 feet of lumber and 270,501,750 shingles against a total traffic by all the railroads of 89,350,500 feet of lumber and 114,000,000 shingles.

OLD AND NEW ROADS.

[Continued from page 63.]

The Decision on the Stanhope Charter.

Vice Chancellor Dodd, in the case of the Pennsylvania Railroad Company against the National Railway Company, decided in favor of the plaintiffs, on grounds which are presented in the following abstract of his decision:

"The Vice Chancellor examined the opinions delivered in the Court of Chancery and the Court of Appeals, in the case of the Camden & Amboy Railroad Company and the Delaware & Raritan Canal Company v. the Raritan & Delaware Bay Railroad Company (1 and 3 C. E. Green's Reports, respectively), and held that the opinion of the latter court (delivered in 1867) that 'after the 1st of January, 1869, when the effect of that (the exclusive privilege) clause will be spent, the defendants, as at present constituted, will have no greater right than they now (1867) have to establish a line of railroad to compete in business with the complainants between the cities of New York and Philadelphia,' must control the Court of Chancery in this case, and that consequently, if the defendants have not the authority, either expressly or by necessary implication, to do a through business between the cities of New York and Philadelphia, they must be enjoined.

"The Vice Chancellor then examined the several charters under which the defendants proposed to build their road, and held that none of them, or all combined, gave any such authority, and the only clause that could be pretended to give the authority was the eighth section of the Stanhope charter, the one alleged to have been interpolated. But this section was foreign to the purposes of the charter; the act was perfect in all its parts, and adequate to accomplish its purposes, without this section. It could clearly not be used for any such object as was in this case sought to be effected by it.

"He remarked that the Stanhope bill was defeated by that section in the Constitution, which says 'to avoid improper influences which may result from intermixing in one and the same act such things as have no proper relation to each other, every law shall embrace but one object, and that shall be expressed in the title.'

"He held that there was no misjoinder. The Pennsylvania Railroad Company are in possession of the works of the United Companies, and have the present actual interest, and the United Companies have the reversionary interest. Together they have the entire estate and interest. They are, therefore, entitled to maintain this suit, though the lease was not filed in the office of the Secretary of State, and recorded in accordance with the act of 1871.

"The delay in filing the bill worked no such harm to the defendants as to deprive the complainants of their right to an injunction.

"The Vice-Chancellor being clearly of the opinion that an injunction should issue upon the view of the case already presented, did not consider the questions whether the Court would otherwise have examined into the alleged fraud in the passage of the act, or, if they would, whether there was sufficient evidence in the case to establish the fraud?

"Upon these views of the case the conviction of the Vice-Chancellor was that the preliminary injunction must be granted against the National Railway, its agents, coadjutors and associates, to restrain them from building this road so as to make it a through road from New York to Philadelphia."

Texas & Pacific.

A correspondent at Dallas, Texas, writes that the piers for the bridge over the Trinity River at Dallas are finished, and the false works for the superstructure are going up. Iron has arrived for 26 miles of the road, and track-laying from the crossing of the Houston & Texas Central at Dallas has been begun, to be pushed on as fast as the iron arrives. The round-house, water-tank and freight depot in Dallas are completed. The depot grounds in Fort Worth are located, the sidings run in, and preparations made for breaking ground there. The grading is completed for 30 miles east of Dallas, and a large force is at work at the East Fork of the Trinity and the Sabine River.

Boston, Hartford & Erie.

This company has announced to the New York Stock Exchange that it deems it inexpedient and unadvisable to reopen the transfer books at present.

The Trenton Bridge over Detroit River.

A telegram from Detroit dated the 4th says:

"By direction of the Secretary of War, proceedings have been instituted in the United States Circuit Court in this city, in the name of the United States against the Detroit River Railroad Bridge Company, which is now building a bridge from Trenton to Grosse Isle, and thence to Stony Island. The injunction is asked for on the ground that the erection of this bridge is in violation of the ordinance of 1787, establishing the Northwestern Territory, which declared that 'streams forming the Canadian boundary shall remain forever free and navigable;' also in violation of the Ashburton Treaty with Great Britain, which expressly provides that the Detroit River and all its channels shall remain free and open for the navigation of vessels of both nations. Various other grounds are alleged, among them that lighthouses have been built and are being built to promote navigation of the west channel, which is likely to become the main navigable channel, etc. No preliminary injunction will be issued, but the building of the bridge will be allowed to proceed, the company taking the chances as to the result of the suit.

Railroad Legislation.

In the Ohio Legislatnre on the 2d a bill passed making railroad companies responsible for debts for labor and materials furnished fot their roads by an order of contractors.

In the Illinois Legislature on the 3d a bill was introduced providing for the election of directors of corporations by the cumulative vote as provided in the new State Constitution. In it is a clause providing that, "at the first annual election for directors or managers of any corporation now organized, which shall occur after this act will take effect, there shall be a full board of directors or managers elected, whose term of office shall be the same as provided in the charter or general laws by virtue of which such corporation was organized, and all laws, or parts of laws, in conflict with this act, are hereby repealed." This repeals the Classification act, by which now the Chicago & Northwestern, the Chicago, Rock Island & Pacific, and perhaps some other companies, elect only one-third of their boards yearly and these for three years.

In the Senate of this Legislature a bill has been introduced which declares railroads public highways; providing, further, that any railroad company feeling itself damaged by this or any State law shall furnish a proof to the Governor before January 1, next, and the Supreme Court shall arbitrate between the road and the State; that any road not furnishing said proof before said date shall be deemed to have consented to be governed by all laws relating to railroads; that any persons or company shall have the right on giving twenty-four hours' notice to any legal agent of any road, to put cars thereon, for hauling which the company, if it furnishes the motive power, may charge not to exceed 3 cents per mile for each freight car of ten tons, and 50 cents per mile for each passenger car, and if it does not furnish the motive power, 30 cents, and 2 cents respectively, besides 24 cents per day per car track charge. The cars may be attached to regular trains or run on special time table, according to agreement. County and city authorities are authorized to condemn land to lay side or connecting tracks.

The Chairman of the House Committee on Railroads has introduced into the Illinois Legislature a bill which forbids the charging by any agent of a railroad company of rates for fare or freight greater than the laws of the State allow under penalty of fines of from $100 to $1,000, recoverable before a justice of the peace, and also forbids the demanding of such rates by any subordinate agent, under penalty of a fine of from $50 to $100, and makes it a misdemeanor, punishable by a fine of from $100 to $200, for a conductor or other person to attempt to eject from a carany person on account of such person's refusal to pay more fare than the law permits.

Erie.

At a meeting of the directors of this company held in New York, February 11, the following statement of the business of the company for the last year was presented:

The gross earnings of the Erie Railway for the year ending December 31, 1872, were		$18,694,096
The working expenses for the same period were	$13,619,956	
Interest on the funded and floating debt	1,814,043	
Rental of leased lines, &c.	1,223,712	16,667,711
Net results for the year		$2,026,385
Less dividend on preferred stock paid to July 1, 1872		298,792
Leaving a surplus of		$1,727,593

It is stated that of the amount charged as working expenses, nearly $4,000,000 was paid for new iron and new work. No allowance was made in any form for the property or securities returned by Jay Gould.

The board resolved to declare a dividend on the preferred stock of three and one-half per cent. out of the earnings for the six months ending December 31, 1872, and a dividend of one and three-quarters per cent. on the common stock out of the earnings for the year. Both dividends will be payable at the Treasurer's office in New York, March 15. The transfer-books will be closed from 2 p. m., March 2, until March 16.

It is also announced that the new loan of $10,000,000 has been very successful, having been taken at par, less 2½ per cent. commission, netting the company 97½ per cent.

It is said to have all been taken by the Union Bank of London, the London Banking Association, and Messrs. Bischoffsheim & Goldschmidt.

New Jersey Railroad.

The bill chartering this company now before the New Jersey Legislature is in effect a Pennsylvania Railroad project. The route laid down in the bill is almost precisely the same as that of the New York & Philadelphia or National project, the corporators are all in the interest of the Pennsylvania Railroad, and this latter company openly appears as the champion of the bill. The Pennsylvania people profess their willingness to agree to have the road completed and in operation within eighteen months and to make full provision for the acommodation of all local traffic. It claims to need another line to accommodate the traffic.

New York & Philadelphia.

The advocates of the bill chartering this new company, which is in fact the same as the National Railway Company, are making a very strong effort to pass the bill through the New Jersey Legislature, since the decision of the Vice-Chancellor enjoining the National Company from continuing work. In case the bill passes, the company will, as soon as it can be organized, take possession of the property and completed work of the National Company and push the work forward. It is asserted, and with some show of truth, that this is the only project of the several now before the Legislature which is presented in good faith, and will, if the bill pass, be really carried out.

Atlantic & Great Western.

A special meeting of the stockholders will be held at the office in New York February 20, to consider and act upon the proposed leases by the company of the Pithole Valley, the Pennsylvania Petroleum and the Shenange & Allegheny railroads.

West Wisconsin.

A bill has passed the Wisconsin Legislature requiring this company to re-lay the track recently taken up betw en Warren's Mills and Tomah, and to commence operating the same by May 15.

Milwaukee & St. Paul.

The first freight train over the extension of the River Division from Winona, Minn., to La Crescent left Winona February 2. No regular time table has been adopted, and no passenger trains have been put on. A temporary arrangement has been made with the Chicago & Northwestern by which the Milwaukee & St. Paul trains will continue to run over the "Winona cut off" from Winona to Winona Junction. It is said that the company has refused to allow the Chicago, Dubuque & Minnesota trains to run over the winter bridge above La Crosse. This action, it is further reported, has been taken on account of the existing difficulties on the bridge question between La Crosse and the Milwaukee & St. Paul Company.

Chicago & Northwestern.

The new line from Winona Minn., to Elroy, Wis., will be run as a distinct division under the title of "the La Crosse, Trempeleau & Prescott Railway, and Madison Extension of the Chicago & Northwestern Railway."

Utah Northern.

A correspondent informs us that this road was completed to Logan, Utah, 33 miles from Brigham Junction and eight miles beyond Hampton's, the late terminus, January 31. The road was, in common with the Utah roads, blocked by the heavy snow storm of February 2.

Mississippi Valley & Western.

This company advertises for proposals for 200,000 ties to b used on the extension from West Quincy, Mo., towards St Louis.

Selma, Rome & Dalton.

A correspondent informs us that the stoppage of trains on this road, which lasted from December 19 to January 2, was caused, not by trouble with the employees, but by a cyclone, which destroyed 13 miles of track and damaged no less than 47 bridges, large and small.

Hoosac Tunnel.

Progress of the Hoosac Tunnel to February 1: Opened from east end, westward, 13,340 feet; opened from west end, eastward, 8,859. Total lengths opened, 22,199 feet. Length of the tunnel, 25,031 feet. Length remaining to be opened, 2,832 feet, being 192 feet more than half a mile.

Dakota Southern.

The completion of this road to Yankton, 65 miles from Sioux City, was celebrated on the 5th instant. In our record of railroad construction in 1872 the statement that the road was completed for 36 miles was a misprint for 56.

Chicago, Clinton & Dubuque.

A telegram from Dubuque dated the 8th says: "The somewhat famous suit that has been long pending in the courts between the present management of the Chicago, Clinton & Dubuque Railroad and Tom Tins, Dennis A. Mahony, *et al.*, who set up a claim to the control of the road and a tract of 43,000 acres of the company's land, terminated yesterday at Andrew, in Jackson County. Judge Ellis, of the Circuit Court, ordered and adjudged that J. R. Graves, J. F. Joy, J. M. Walker. J. A. Rhomberg, Nathaniel Thayer, H. H. Hunnewell, J. W. Brooks, Sidney Bartlett and J. A. Burnham be, and they are hereby, recognized and confirmed as the present legal directors of the Chicago, Clinton & Dubuque Railroad Company, and that said J. K. Graves is the President, and Joseph A. Rhomberg the Vice-President, and Peter Kiene, Jr., the Secretary, and legal officers of said board of directors."

Galveston, Harrisburg & San Antonio.

This road now extends from Harrisburg, Tex., which is on the Galveston, Houston & Henderson road 44 miles from Galveston, west 83 miles to Columbus. It is intended to push the road forward to San Antonio, and work is shortly to be commenced on the first section of 40 miles west from Columbus. The engineering parties are now making a final location of the line. The distance from Columbus to San Antonio is about 115 miles.

Milwaukee & Northern.

The Milwaukee (Wis.) *Sentinel*, of February 4, says: "We understand that negotiations have been going on or some time past, with the view of connecting the track of the Milwaukee & Northern Railway with the track of the new Fond du Lac Air Line Railway, where they cross each other near Schwartzburg, six miles from the city, so as to enable the cars of the Milwaukee & Northern Company to run directly into the new depot on the lake shore."

Wisconsin Valley.

A dispatch from Dubuque, Ia., says that the iron for the line from Tomah, Wis., to Grand Rapids, 45 miles, has been purchased and rolling stock ordered. The work on the road will be pushed forward and tracklaying commenced early in the season.

Chicago, Huntington & Dayton.

This company, which filed its articles of incorporation with the Secretary of State of Indiana, February 5, purposes to build a railroad from the Ohio State line in Jay County, northwest to Huntington on the Toledo, Wabash & Western road, about 50 miles. The road is intended to be a link in the proposed line from Dayton, O., to Chicago. The capital stock is to be $1,000,000, and the directors are: William McGrew, Cyrus E. Bryant, Jesse Davis, William Ewing, Daniel S. Leyman, Jonas Votaw and S. S. Arthur.

Millstone & New Brunswick.

A supplement to the charter of this company authorizes it to extend its road from the present junction with the New Jersey road south of New Brunswick through that town, crossing the Raritan below the present railroad bridge and thence north to Elizabeth. The company is also authorized to increase its capital stock $500,000. The road has always been operated as the Millstone Branch of the New Jersey Railroad, and is now leased to the Pennsylvania Railroad Company. It is possible that that company desires to obtain authority to construct a second line from New Brunswick to Elizabeth.

Spartanburg & Union.

This road, which extends from Alston, S. C., on the Greenville & Columbia road, northwest 56 miles to Spartanburg, was sold under foreclosure, February 4, to R. Y. McAden of Charlotte, N. C. At Spartanburg the road connects with the Atlanta & Richmond Air Line.

Paris, Neoga & St. Louis.

A correspondent informs us that negotiations are in progress which will probably result in the early construction of this road from Rockville, Ind., on the Logansport, Crawfordsville & Southwestern road, through Paris and Neoga, Ill., to St. Louis.

Annual Meetings.

The Delaware, Lackawanna & Western Company meets at noon at No. 26 Exchange place, New York, February 25. Transfer books will be reopened the next day.

The St. Louis, Kansas City & Northern Company will meet in St. Louis, March 4, and the polls will be open from 10 a. m. to 1 p. m. Transfer books will be reopened March 5.

The Union Pacific Company will meet at its office in Sears' Building, Boston, March 5, at 10 a. m. Transfer books will be closed after February 22.

THE SCRAP HEAP.

Prices of Rails in January.

Bigelow & Johnston, of No. 48 Pine street, New York, reports as follows the prices current of rails for the month of January, 1873:

	Gold.	Currency.	Import, Tons
New Rails.			
Foreign	$72 @ 73		
*American		$71½ @ 85	
Import at New York this month			2,613
†Same time 1872			8,296
†Same time 1871			10 040
Steel.			
Foreign	$112 @ 115		
*American		$125	
Import at New York this month			3,776
Old Rails.			
Double heads		$57 @ 58	
T or flange		$56 @ 57	
U or bridge		Nominal.	
Import at New York this month			1,789
Same time 1872			4,163
Same time 1871			4,058

* These prices represent as nearly as possible the range, according to location of mill.

† These figures included steel.

New Rails.—The demand during the month has been of a very light character both for foreign and American, at the same time prices are maintained firmly. The trade abroad is in a very anomalous condition owing to the great strikes in Wales, and until these disturbing elements disappear, it will be almost impossible to forecast the future. For steel there is considerable inquiry.

Old Rails.—The arrivals have been very light and, judging by the wide difference between the European markets and this, are likely to become very scarce as soon as our present stock has been worked off. Prices have gradually hardened, though without any general demand. The stock is concentrated in few hands and strongly held.